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WATER REUSE AND ENVIRONMENTAL CONSERVATION PROJECT

CONTRACT NO. EDH-I-00-08-00024-00 ORDER NO. 04

Environmental Considerations Report for
Aqaba Waste Management and Landfill Design
Report.

June 2015

IMPLEMENTED BY AECOM

This document was produced for review by the United States Agency for International Development. It was prepared by AECOM.

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Submitted to:
USAID Jordan

Prepared by:
AECOM

DISCLAIMER:

The authors' views expressed in this document do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

TABLE OF CONTENTS

1	Introduction.....	1
1.1	Project Background and Need for the Project.....	1
1.2	Environmental Considerations Report Objectives.....	1
2	Regulatory Framework.....	3
2.1	Laws	3
2.1.1	Environment Protection Law (No. 52 of 2006)	3
2.1.2	Public Health Law (No. 47 of 2008)	3
2.1.3	Archaeology Law (No. 21 of 1988)	3
2.1.4	Water Authority Law (No. 19 of 1988)	3
2.1.5	Agriculture Law (No. 44 of 2002)	3
2.1.6	Labor Law (No. 8 of 2002).....	4
2.2	Bylaws.....	4
2.2.1	Environmental Impact Assessment Regulations (No. 37 of 2005)	4
2.2.2	Regulation for Protection of the Environment in ASEZ (No. 21 for 2001).....	4
2.2.3	Regulation for the Prevention of Health Nuisances (No. 72 of 2009)	4
2.2.4	Regulation for the Protection and Safety of Workers from Machineries and Workplaces (No. 43 of 1998).....	4
2.2.5	Regulation of Preventive and Therapeutic Medical Care for the Workers in Establishments (No. 42 of 1998)	5
2.2.6	Air Protection Bylaw (No. 28 of 2005).....	5
2.2.7	Solid Waste Management Bylaw (No. 27 of 2005)	5
2.2.8	Soil Protection Bylaw (No. 25 of 2005)	5
2.2.9	Environmental Monitoring and Inspection Regulation (No. 65 of 2009)	5
2.2.10	Regulation for Protecting the Environment from Pollution in Emergency Situations (No. 26 of 2005)	5
2.2.11	Groundwater Control Regulation (No. 85 of 2002).....	6
2.2.12	Water Protection Regulation of 2004.....	6
2.2.13	Regulation of Land Use of 2007	6
2.2.14	Hazardous Materials and Wastes Management, Transfer and Circulation Regulation (No. 24 of 2005)	6
2.2.15	Regulation for the Formation of Committees and Moderators of Occupational Safety and Health (No. 7 of 1998)	6
2.3	Instructions, Regulations, Standards and Codes	7
2.3.1	Instructions for the Protection of Workers and Institutions from Workplace	7
2.3.2	Instructions for Preliminary Medical Testing of Workers of 1998	7

2.3.3	Instructions for Regular Medical Testing of Workers of 1998.....	7
2.3.4	Water Resources Protection Guidelines of 2011	7
2.3.5	Instruction for the Management and Handling of Consumed Oil of 2003	7
2.3.6	Instruction for Management and Handling of Hazardous Waste of 2003	7
2.3.7	Instructions for Noise Prevention of 2003	7
2.3.8	Ambient Air Quality Standards (Jordan Standard [JS] 1140 of 2006)	8
2.3.9	Jordanian Building Codes	8
2.3.10	Jordanian Code No. 22: Public Safety during Construction	9
3	Institutional Framework.....	11
3.1.1	ASEZA	11
3.1.2	Ministry of Water and Irrigation, including Jordan Valley Authority (JVA) and Water Authority of Jordan (WAJ)	11
3.1.3	Ministry of Health (MOH).....	11
3.1.4	Ministry Of Labor (MOL).....	12
3.1.5	The Royal Society for the Conservation of Nature (RSCN).....	12
4	Description of the Proposed Project.....	13
4.1	Project Location	13
4.2	Project Objectives	14
4.3	Project Components.....	14
4.4	Existing Solid Waste Management Conditions	14
4.4.1	Waste Generation and Collection	14
4.4.2	Solid Waste Disposal	15
4.4.3	Waste Recycling	16
4.5	Project Alternatives	17
4.5.1	Alternative 1: No-Action Alternative	18
4.5.2	Alternative 2: Engineered Sanitary Landfill	18
5	Description of the Study Area	21
5.1	Climate.....	21
5.2	Geology and Soil.....	22
5.3	Topography	24
5.4	Groundwater	25
5.5	Surface Water	26
5.6	Unconventional Water Resources	27
5.7	Air Quality	27
5.8	Noise.....	28
5.9	Flora and Fauna.....	28
5.10	Antiquities	31

5.11	Land Use.....	32
5.12	Population and Major Economic Activities	34
5.13	Transportation	35
5.14	Infrastructure (Water, Wastewater and Electricity).....	38
5.15	Solid Waste	40
5.16	Human Health	40
6	Initial Assessment of Environmental Impacts and Mitigation Measures.....	43
6.1	Impacts Associated with No-Action Alternative	43
6.2	Impacts Associated with Implementation of Project	43
6.2.1	Construction Phase	43
6.2.2	Operation Phase	48
7	Initial Environmental Management and Monitoring Plan	53
7.1	Proposed Mitigation Measures	53
8	Proposed Environmental Impact Assessment Methodology and Schedule	59
8.1	Literature and Data Review	59
8.2	Field Investigations	59
8.2.1	Surface Water and Groundwater Assessment.....	59
8.2.2	Air Quality and Noise Baseline Study	60
8.2.3	Ecological Assessment	60
8.2.4	Socio-economic Study.....	60
8.2.5	Human Health Assessment.....	61
8.3	Scoping.....	61
8.4	Environmental Impact Identification and Assessment.....	61
8.5	Environmental and Social Management and Monitoring Plan Development	61
8.6	Approvals	62
8.7	Disciplines Required.....	62
8.8	Proposed EIA Report Outline	62
8.9	Schedule	63
9	Conclusions	6564
10	References	6766

List of Tables

Table 2-1: Maximum Allowable Noise Levels	8
Table 2-2: Allowable Limits of Ambient Air Pollutants	9
Table 2-3: Relevant Treaties, Conventions and International Agreements Ratified by Jordan.....	10
Table 5-1: Climatic Information for Selected Months for Aqaba Airport Station	21
Table 5-2: Users and Quantities of Reclaimed Water from Aqaba WWTP	27
Table 5-3: Main Fauna found in Aqaba Mountains Protected Area	31
Table 5-4: Zoning Categories of Aqaba	32
Table 5-5: Population of Aqaba Governorate according to District and Sub-district, 2013	34
Table 5-6: Employed Persons Age 15+ in the Industry Sector for Year 2012 in Aqaba Governorate	35
Table 5-7: Length of Road Networks by Type of Road, 2013	35
Table 5-8: Number of Road Accidents, Type of Accident and Number of Casualties in the Governorate of Aqaba, 2013	36
Table 5-9 : Type and Number of Health Centers in Aqaba Governorate, 2013	40
Table 5-10: Disease in Aqaba Health Directorate and in Jordan, 2013.....	41
Table 7-1: EMMP during Construction Phase	54
Table 7-2: EMMP during Operation Phase	57

List of Figures

Figure 4-1: General Location of Aqaba.....	13
Figure 4-2: Current and Old Aqaba Landfill Sites.....	14
Figure 4-3: Old Landfill Site (blackened piles)	15
Figure 4-4: Current Dumping Site	16
Figure 4-5: Scavenged Recyclables	16
Figure 4-6: Temporary Onsite Camp for Scavengers	17
Figure 4-7: Location of Carton Collection at Safeway Supermarket	17
Figure 4-8: Proposed Landfill Design.....	20
Figure 5-1: Monthly Average Temperature and Rainfall in Aqaba.....	21
Figure 5-2: Geological Map of the Project Area	23
Figure 5-3: Topographic Map	24
Figure 5-4: Terrain of the Project Site.....	25
Figure 5-5 : Jordan Groundwater Basins with Special Emphasis on Disi Aquifer	26
Figure 5-6: Project Location according to Bio-geographical Zones of Jordan	29
Figure 5-7: Landfill Site Relevant to Wadi Rum and Aqaba Proposed Reserve-with 3D View	30
Figure 5-8: Aqaba Important Bird Area (IBA)	31
Figure 5-9: Aqaba Castle.....	32
Figure 5-10: Land Use Map of Aqaba According to the ASEZ Master Plan 2011-2030	33
Figure 5-11: Road Network at Aqaba	37
Figure 5-12: Access Road to Project Location	38
Figure 5-13: Existing Electricity Transmission Grid	39
Figure 5-14: Waste Composition of Jordan.....	Error! Bookmark not defined. 40

APPENDICES

Appendix A: Conditions for Developing within Conditional Development Areas

LIST OF ACRONYMS

ASEZA	Aqaba Special Economic Zone Authority
AWC	Aqaba Water Company
CDA	Conditional Development Areas
dBA	A-weighted decibel(s)
DOA	Department of Antiquities
ECR	Environmental Considerations Report
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
ESMP	Environmental and Social Management and Monitoring Plan
H&S	Health and Safety
HASP	Health and Safety Plan
IBA	Important Bird and Biodiversity Area
IEE	Initial Environmental Examination
JS	Jordanian Standard
JVA	Jordan Valley Authority
MOA	Ministry of Agriculture
MoEnv	Ministry of Environment
MOH	Ministry of Health
MOL	Ministry of Labor
MoU	Memorandum of Understanding
MRF	Materials Recovery Facility
MSW	Municipal Solid Waste
MWI	Ministry of Water and Irrigation
P2	Pollution Prevention
PM ₁₀	Particulate Matter with diameter of 10 micrometres or less
PM _{2.5}	Particulate Matter with diameter of 2.5 micrometres or less
PPE	Personal Protective Equipment
RSCN	Royal Society for the Conservation of Nature
TSP	Total Suspended Particulates
WAJ	Water Authority of Jordan
WWTP	Wastewater Treatment Plant

ACKNOWLEDGMENT

This document was prepared by a multidisciplinary team, including engineers and scientists, from Engicon, under direction by AECOM.

1 INTRODUCTION

1.1 Project Background and Need for the Project

The USAID WRECP works throughout Jordan in institutional capacity building, pollution prevention (P2) for industries, solid waste and wastewater management, and water reuse. The project is implemented by AECOM and a team of international and Jordanian partner firms. This five-year project has four primary tasks:

- Task 1 – Institutional and Regulatory Strengthening
- Task 2 – Pollution Prevention and Industrial Water Management
- Task 3 – Disposal Sites Rehabilitation and Feasibility Studies
- Task 4 – Water Reuse for Community Livelihood Enhancement

The overall objective of WRECP is to protect Jordan's water supply through the achievement of the following goals:

- Strengthen the ability of government agencies to monitor and regulate industrial wastewater handling and reuse
- Strengthen the ability of qualified laboratories to analyze industrial wastewater samples, to tell whether it is being treated properly
- Help industries gain access to technologies and expertise to reduce pollution and conserve water and energy
- Improve waste management practices at landfills and improve industrial wastewater treatment
- Help communities generate income through water reuse projects
- Increase public awareness of the benefits of water reuse and proper waste management

One of the main project components (Task 3) is solid waste management and rehabilitation of disposal sites, including Aqaba landfill. The existing landfill is divided into two areas: the old landfill and active landfill parts. The old landfill consists of blackened piles resulting from previous burning practices back in the 1980s. Currently, waste is left uncovered and un-compacted in an unlined base which has an adverse impact on soil, water and air, in addition to raising concerns regarding vector breeding and landfill fires. Contracted laborers collect recyclables directly from waste, which poses health hazards, putting them at risk of being infected and exposed to contaminants.

The primary challenge concerning the Aqaba site is to develop an integrated solid waste management plan, consisting of a waste segregation/treatment facility and a properly engineered sanitary landfill.

1.2 Environmental Considerations Report Objectives

A screening process was conducted for the WRECP according to USAID's Environmental Compliance Procedures, Title 22, Code of Federal Regulations, Part 216. USAID conducted an Initial Environmental Examination (IEE) for the various components of the WRECP. As USAID's action is limited to the funding of a feasibility study and preparation of design documents, the IEE concluded that USAID's actions (i.e., studies/design) would not have the potential for significant adverse environmental impact. However, USAID recognized that implementation (e.g., construction/implementation) of recommendations made in the feasibility study and depicted in design documents could have potential adverse impacts if not implemented with appropriate controls, or if environmental monitoring is not incorporated

into the project. The IEE noted that an Environmental Mitigation and Monitoring Plan, hereafter referred to as an Environmental Management and Monitoring Plan (EMMP) should be prepared, to ensure minimal adverse impacts on human health and the environment for these activities. Further, the IEE determined that the environmental assessment process should be followed in accordance with USAID's Environmental Compliance Procedures.

The present report is an Environmental Considerations Report (ECR). This ECR was not prepared to be a formal Environmental Assessment; instead, it was prepared to ensure that potential environmental impacts are considered by the design team while making a decision on the recommended plan, and during development of the preliminary design. This ECR includes an EMMP to facilitate the implementation of the proposed action in a manner that enhances and sustains the natural and human environment. During implementation of the proposed landfill final design and construction, an Environmental Impact Assessment (EIA) in compliance with Aqaba Special Economic Zone Authority (ASEZA) regulations must be prepared and will include the major results, conclusions, and recommendations of this study.

This ECR plays a central role in assessing the social and environmental implications of the proposed project, identifying the measures necessary to protect resources and related ecosystems, and then ensuring that such measures are implemented. The ECR is concerned not only with impacts on the natural environment, but also with effects on the health and social environment.

The ECR describes various components of the environment of the area(s) to be affected by the alternative under consideration. Data and analyses in the ECR are commensurate with significance of the impact. The ECR includes discussions of direct effects and their significance, indirect effects and their significance, policies and controls for the areas concerned, the reuse and conservation potential of the recommended alternative, and mitigation measures. For each significant adverse impact, the mitigation discussions propose measure(s) that will minimize its magnitude and severity.

The main objectives of this ECR for Aqaba Landfill are summarized below:

1. Ensure that the project will not have irreversible negative impacts on the natural and human environments
2. Identify and compare the potential environmental impacts, including the positive and negative, and direct and indirect impacts of the recommended alternative
3. Evaluate the reasonableness of the alternatives to the recommended alternative and specify those alternatives that should be assessed in the EIA
4. Propose mitigation and monitoring measures for minimizing the potential adverse impacts of the project on the affected environment

2 REGULATORY FRAMEWORK

2.1 Laws

2.1.1 Environment Protection Law (No. 52 of 2006)

In 2006, the Jordanian Law for Protection of the Environment was decreed. Article 5 of this law states that the Ministry of Environment (MoEnv), in cooperation and coordination with the authorities concerned with environmental affairs at the local, Arab and international levels, shall be responsible for the protection of the environment elements and components from pollution.

To ensure that the MoEnv is able to do that, complementary regulations and instructions were issued pursuant to the Law.

According to Article 13 of the law, companies, establishments or entities that conduct activities which negatively impact the environment should prepare an EIA report for their projects and submit such report to the MoEnv to take the appropriate decision in its regard.

2.1.2 Public Health Law (No. 47 of 2008)

The Ministry of Health (MOH) is the entity responsible for applying the Public Health Law in Jordan. The Ministry is also authorized to take all necessary measures to protect public health. Article 47 considers activities that affect human health or cause a health nuisance by releasing solid or liquid waste or emitting gases. Article 48 states that entities responsible for creating health nuisance are given seven days' notice to apply corrective measures. If nothing is done, the MOH will carry out the required actions at the expense of the activity owner.

2.1.3 Archaeology Law (No. 21 of 1988)

Issued by the Ministry of Tourism / Department of Antiquities (DOA), the law details the main responsibilities of the DOA. These include but are not limited to determining the archaeological sites along with their importance, carrying out archaeological excavations, and maintenance, preservation and restoration of archaeological sites. Article 13 of this law bans construction of any structure within a distance of 5 to 25 meters from an archaeological site. Article 15 states that any chance finds should be reported to DOA or the Public Security Directorate within 10 days. Article 27 sets the penalties for failing to report chance finds.

2.1.4 Water Authority Law (No. 19 of 1988)

The Water Authority Law and its amendments established the Water Authority of Jordan (WAJ) as an autonomous agency responsible for all water and wastewater issues in the country. WAJ's mandate includes connecting the public to the water and sewer networks, as well as maintaining, operating, and managing these networks.

2.1.5 Agriculture Law (No. 44 of 2002)

This law identifies the responsibilities of the Ministry of Agriculture (MOA) in regulating and developing the agricultural sector, in cooperation with the relevant authorities. In addition, Article 57 governs the protection of wild animals and birds and prevents the hunting, killing or capture of birds useful for agriculture, as well as birds and animals of prey. The types and species subject to this regulation are specified by the Minister. The law further governs the protection of agricultural land and pastures.

2.1.6 Labor Law (No. 8 of 2002)

The key component of this law is stated by Article 56 paragraphs (A) and (B) regarding the right of the laborer to not work more than eight hours per day. Furthermore, Article 73 of this law bans the employment of individuals less than 16 years of age. The Law also states that projects shall comply with article 78 related to occupational health and safety, and provides essential precautions and arrangements to protect the workers from the risk of hazards, including the supply of Personal Protective Equipment (PPE).

2.2 Bylaws

2.2.1 Environmental Impact Assessment Regulations (No. 37 of 2005)

The EIA regulations were issued to ensure that the anticipated impacts of any development project on the social, economic, and natural environment in Jordan are identified. Their aim is to limit these impacts in order to achieve sustainable development in the country. The regulations apply to all industrial, agricultural, commercial, construction, residential, and tourism projects. The level and type of EIA study is determined by the MoEnv, consistent with the lists of Category 1 and Category 2 projects specified in Annex 2 and Annex 3 of the regulation. This regulation also states that the EIA review period for the MoEnv is 45 calendar days.

2.2.2 Regulation for Protection of the Environment in ASEZ (No. 21 for 2001)

Issued in 2001, the ASEZA Environment Protection Regulation aims to ensure that all projects in this zone are subject to an Environmental Impact Assessment (Article 9). The assessment and its process should be approved by ASEZA. According to Article 8, the objective of the EIA is to “identify, examine and define the impacts of a Project on the Environment, its effects on, and how it is affected by the economic and social aspects”. The process should also propose means to reduce the adverse impacts and shall be undertaken during the planning, design, execution, and operation phases of a project.

In Article 39 of the regulation, throwing, treating, or incinerating solid waste is prohibited except in designated places away from residential areas and water channels. Article 46 states that persons engaging in construction activities resulting in wastes or soils are responsible for their storage, safe transport, and unloading in specified locations. Another important requirement in the regulation is that “all closed and semi-closed places should fulfill sufficient ventilations means in proportionate with the size, capacity and type of activity of such place” (Article 51).

2.2.3 Regulation for the Prevention of Health Nuisances (No. 72 of 2009)

The provisions of this regulation prohibit anyone from causing any health nuisances within municipal areas. It identifies the types of nuisances and the measures to be undertaken to prevent the occurrence of health nuisances.

2.2.4 Regulation for the Protection and Safety of Workers from Machineries and Workplaces (No. 43 of 1998)

The provisions of this regulation obligate any institution to take precautions and procedures to ensure prevention of occupational accidents. It identifies types of safety risks at work sites, including mechanical, chemical and electrical machinery and industrial equipment.

2.2.5 Regulation of Preventive and Therapeutic Medical Care for the Workers in Establishments (No. 42 of 1998)

The provisions of this regulation obligate any institution to ensure the medical capability of workers via preliminary and regular medical examinations.

2.2.6 Air Protection Bylaw (No. 28 of 2005)

This bylaw was issued in accordance with Article 23 of the Environmental Protection Law (No.1, 2003). The aim of the Air Protection Bylaw is to protect public health and the environment from pollution resulting from human activities by controlling air pollutants emitted from stationary and mobile sources. It states that for any facility the leak or emission of air pollutants should not exceed the maximum allowable limits. The MoEnv classifies establishments according to the quality and quantity of air pollutants and contaminants resulting from their activities, and their effects on the environment and public health; this classification is used to determine the appropriate location of the facility. The MoEnv is responsible for detecting any excesses and monitoring the compliance with this bylaw.

2.2.7 Solid Waste Management Bylaw (No. 27 of 2005)

The MoEnv is responsible for applying this bylaw which aims to establish a solid waste management system that would protect the environment and the public health. Under this bylaw, the MoEnv is responsible for designating appropriate dumping sites along with detailing the requirements of solid waste collection, transport, storage, recycling, treatment and disposal.

2.2.8 Soil Protection Bylaw (No. 25 of 2005)

Article 3-E of this bylaw states that the MoEnv, in coordination with the relevant authorities, is responsible for protecting soil from the harmful effects of industrial dust, solid waste, industrial waste and untreated wastewater. The regulation further states that the Ministry, in cooperation with the MOA, is responsible for studying the sites of development projects and project impacts on land and natural resources, as well as preparing the necessary programs for the rehabilitation of waste dumping sites and their cultivation with appropriate crops.

2.2.9 Environmental Monitoring and Inspection Regulation (No. 65 of 2009)

This regulation was issued pursuant to the Environmental Protection Law No. 52 of 2006. It categorizes three levels of operational facilities based on their potential to cause environmental pollution. This categorization is reflected in the frequency of environmental inspections stipulated in the regulation. In cases where environmental inspections carried out by the MoEnv reveal violation of stated environmental quality requirements, the MoEnv is authorized to request an environmental audit from the facility, which under Article 9 of the regulation is obliged to submit its audit reports to the MoEnv.

2.2.10 Regulation for Protecting the Environment from Pollution in Emergency Situations (No. 26 of 2005)

This regulation sets out the plan for “protecting the environment and controlling pollution in emergency situations and the methods of implementation thereof, subject to the specific international and regional protocols in this regard to which the Kingdom is party”. In addition, MoEnv is responsible for managing the emergency plan and following up on its execution, as well as identifying the necessary resources and conducting the required surveys and studies.

2.2.11 Groundwater Control Regulation (No. 85 of 2002)

This regulation was issued pursuant to Articles 6 and 32 of the Water Authority Law No. 18 of 1988. It governs groundwater extraction and designates groundwater as exclusive government property. The regulation additionally controls the drilling of wells and the licensing thereof, as well as quality and pollution control and remediation. Furthermore, Criminal Law No. 16 of 1960 stipulates the protection of water resources and sets out the penalties in the case of violations.

2.2.12 Water Protection Regulation of 2004

This regulation aims at protecting water sources from pollution. It stipulates that the Ministry of Water and Irrigation (MWI) is to set the environmental conditions to be fulfilled if permission and authorization are to be given for the development projects covered by the environmental impact assessment regulation.

Additionally, Article 6 of the regulation states that no waste dump sites can be constructed without the MWI's authorization and states that MWI, in coordination with the concerned entities, should set the environmental criteria, conditions and requirements for such a facility. Article 11 further highlights the role of MWI and other concerned entities in setting the environmental conditions for the collection, storage and transportation of all liquid and solid waste in order to prevent the pollution of water sources.

2.2.13 Regulation of Land Use of 2007

This regulation applies to all land uses, including buildings and any construction works undertaken. It designates that the Higher Planning Council is responsible for regional planning and for establishing planning zones. It sets out the different land use categories and defines the relevant allowable activities.

2.2.14 Hazardous Materials and Wastes Management, Transfer and Circulation Regulation (No. 24 of 2005)

This regulation prohibits dealing with hazardous waste or dangerous substances unless a permit is obtained from MoEnv. Per this regulation, the Ministry should form a committee that classifies hazardous waste or dangerous substances and should prepare instructions to determine the basis and conditions for the handling, collection, storage, treatment and disposal of hazardous waste and dangerous substances.

2.2.15 Regulation for the Formation of Committees and Moderators of Occupational Safety and Health (No. 7 of 1998)

The provisions of this regulation obligate any institution that has more than 20 employees to form a functionally specialized committee for the occupational safety and health of the employees. The size of the committee so formed should be commensurate with the size of the institution. The regulation also specifies the responsibilities of this committee.

2.3 Instructions, Regulations, Standards and Codes

2.3.1 Instructions for the Protection of Workers and Institutions from Workplace Risks and Hazards of 1998

These instructions specify mitigation measures that should be taken within trades, industries and crafts to ensure the occupational safety and health of workers and reduce risk factors in facilities.

2.3.2 Instructions for Preliminary Medical Testing of Workers of 1998

These instructions designate types of industries in which workers should be subject to a preliminary medical examination to check their capability to perform their assigned work.

2.3.3 Instructions for Regular Medical Testing of Workers of 1998

These instructions designate types of industries in which workers should be subject to certain medical examinations regularly.

2.3.4 Water Resources Protection Guidelines of 2011

The guidelines aim at defining the protection zones for both surface and groundwater, establishing three defined protection zones and identifying the allowed activities within each zone.

2.3.5 Instruction for the Management and Handling of Consumed Oil of 2003

These instructions identify the oils that are refined from crude oil or synthetic oils and those that have been used and have become contaminated waste and therefore must be disposed of or treated to be reused. These instructions prohibit the discharge of these oils into sewage systems, septic tanks, surface water sources, groundwater or to the environment, and specify all the requirements for the proper handling and disposal of these oils.

2.3.6 Instruction for Management and Handling of Hazardous Waste of 2003

These instructions identify all types of hazardous wastes and prohibit the discharge of these wastes into sewage systems, surface water, groundwater or to the environment. They also specify all the requirements and steps for proper handling, storage, transportation and disposal of these wastes.

2.3.7 Instructions for Noise Prevention of 2003

These instructions address ambient noise and were issued by the MoEnv in 2003. Article 6 of the instructions specifies the maximum allowable level of noise for the different types of areas, both during the daytime and at night.

According to the Instructions for Controlling and Preventing Noise, construction works that use noisy equipment like mixers and shakers and any other similar equipment between 8 pm and 6 am are prohibited except for cases approved by the Ministry.

Table 2-1 displays the allowable maximum limit of the equivalent volume level in A-weighted decibels (dBA) per area.

Table 2-1: Maximum Allowable Noise Levels

Area	Maximum limit for equivalent sound level (dBA)	
	Day	Night
Residential areas in cities	60	50
Residential areas in suburbs	55	45
Residential areas in villages	50	40
Residential areas that have some workshops or simple vocations or business and commercial and administrative areas and downtown	65	55
Industrial areas (heavy industrial)	75	65
Tuition, worshipping and treatment places and hospitals	45	35

2.3.8 Ambient Air Quality Standards (Jordan Standard [JS] 1140 of 2006)

These standards designate ambient air pollutants and the maximum allowable concentration for each of those pollutants in the atmosphere, in addition to approved methods of measurement. Table 2-2 shows the maximum allowable limits for some of the ambient air pollutants listed in JS 1140/2006. The project should comply with these limits during construction and during operations.

2.3.9 Jordanian Building Codes

In 1993, the Government of Jordan issued the Building Code Law No. 7 of 1993, which led to the creation of the Jordan Building Code Commission. The Commission, led by the Ministry of Public Works and Housing, was designated the responsibility of preparing building codes for the country. Since then, the Commission has published 32 building codes regarding the design and construction of buildings in Jordan. For any building design to obtain clearance in Jordan, it has to be approved by the Jordanian Engineers' Association, Civil Defense Directorate, and the Earthquake Commission. These agencies ensure that the design abides by these codes, many of which address environmental, health, and safety issues and are relevant to the building. They are as follows:

- Jordanian Code No. 3: Loads and Forces (Section 4: Earthquake Actions)
- Jordanian Code No. 15: Fire Protection
- Jordanian Code No. 16: Natural Ventilation
- Jordanian Code No. 17: Natural Lighting
- Jordanian Code No. 18: Water Supply for Buildings
- Jordanian Code No. 19: Wastewater for Buildings
- Jordanian Code No. 20: Beautification of the City
- Jordanian Code No. 21: Solid Waste
- Jordanian Code No. 22: Public Safety during Construction
- Jordanian Code No. 23: Electrical Installation
- Jordanian Code No. 27: Fire Alarm Systems
- Jordanian Code No. 32: Building Requirements for the Physically Challenged

Table 2-2: Allowable Limits of Ambient Air Pollutants

Pollutant	Averaging Period	Maximum Limit	Number of Times Limit is Allowed to be Exceeded
Sulfur Dioxide (SO ₂)	1 hour	0.3 ppm*	3 times in any 12-month period
	24 hours	0.14 ppm	Once a year
	Annual	0.04 ppm	-
Carbon Monoxide (CO)	1 hour	26 ppm	3 times in any 12-month period
	8 hours	9 ppm	3 times in any 12-month period
Nitrogen Dioxide (NO ₂)	1 hour	0.21 ppm	3 times in any 12-month period
	24 hours	0.08 ppm	3 times in any 12-month period
	Annual	0.05 ppm	-
Ozone (O ₃)	1 hour	0.12 ppm	-
	8 hours	0.08 ppm	-
Particulate Matter 10 (PM ₁₀)	24 hours	120 µg/m ³ **	3 times in any 12-month period
	Annual	70 µg/m ³	-
Particulate Matter 2.5 (PM _{2.5})	24 hours	65 µg/m ³	3 times in any 12-month period
	Annual	15 µg/m ³	-
Total Suspended Particulates (TSP)	24 hours	260 µg/m ³	3 times in any 12-month period
	Annual	75 µg/m ³ (geometric average)	-
Lead (Pb)	Seasonally	1 µg/m ³	-
	Annual	0.5 µg/m ³	-
Phosphates (P ₂ O ₅)	24 Hours	100 µg/m ³	3 times in any 12-month period
	Annual	40 µg/m ³	-
Cadmium (Cd)	Annual	0.005 µg/m ³	-

*ppm: parts per million

**µg/m³: microgram per cubic meter

Reference: Jordan Ambient Air Quality Standards (JS 1140/2006)

2.3.10 Jordanian Code No. 22: Public Safety during Construction

The Code of Public Safety during Construction describes the required measures to be taken in order to safeguard the work environment during construction works. This includes sanitation, toilet facilities, drinking water, medical services, protection from fires, lighting, ventilation, noise, gasses, electrical wiring, openings and edges, transporting workers, solid waste collection and disposal, and insects and harmful animals. For example, noise levels and exposure periods permitted for workers are set forth under this code.

There are numerous international and regional agreements, which Jordan is a signatory to or has reached with other entities, which are of some relevance to the ECR and this project. These are listed in Table 2-3.

Table 2-3: Relevant Treaties, Conventions and International Agreements Ratified by Jordan

Treaties, Conventions, and International Agreements	Year (in force)	Description
Convention on Wetlands of International Importance Especially as Waterfall Habitat (Ramsar Convention)	1971	- Protects all characteristic flora and fauna, with emphasis on protection of the waterfall habitats.
The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	1979	- Regulates export and import of listed Endangered species of fauna and flora. - Additionally allows Parties to give protection to selected species of flora and fauna within their jurisdiction.
The United Nations Convention on Biological Diversity (Bonn)	1993	- Calls for identification and monitoring of biodiversity components. - Calls for establishment of protected areas and emergency response plans.
Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa	1994	- Calls for combating desertification. - Calls for mitigating the effects of drought.
The United Nations Framework Convention on Climate Change	1994	- Calls for stabilization of greenhouse gas emissions, and requires Parties to prepare greenhouse gas inventories.

3 INSTITUTIONAL FRAMEWORK

3.1.1 ASEZA

ASEZA was established in 2001 to develop Aqaba as a regional hub for trade, tourism and culture. Offering integrated services and assistance to every concerned business, it ensures all governing laws and regulations of ASEZ are made public. ASEZA is operated through six ministerial-level commissioners, each responsible for a major area of regulatory or operational activity. One of the commissioners is dedicated to the Environmental Management of the Zone, which illustrates the importance of the environment to the Authority. The Commissioner for Environment and Health Control helps to develop the necessary regulations and procedures to protect the environment and to establish cooperation with the local community, national and international environmental organizations in order to protect and contribute to the sustainable development of the Zone through finding the balance between investment requirements and the protection of the natural resources for future generations.

ASEZA is the entity responsible for the preservation and protection of the environment and sustained development of Aqaba's natural resources. It is also responsible for reviewing EIA studies and granting approvals for projects, as well as being the entity responsible for monitoring environmental compliance and protection of environmental components throughout the construction and operation of projects.

3.1.2 Ministry of Water and Irrigation, including Jordan Valley Authority (JVA) and Water Authority of Jordan (WAJ)

MWI and its respective authorities (WAJ and JVA) are specifically responsible for the protection of water resources. The main objective of MWI is to maintain sustainable water resources with the purpose of achieving national water security and meeting the Ministry's development objectives.

WAJ is the entity that assumes all authority pertaining to water and wastewater in Jordan, including the management of WWTPs. The Authority's role further involves the improvement of the relevant infrastructure for the purposes of preserving public health and the environment. Objectives of JVA include protecting water resources from pollution and depletion and protecting soils from degradation.

3.1.3 Ministry of Health (MOH)

MOH is the entity accountable and responsible for public health and safety monitoring and control and assumes the responsibility for all health affairs across the Kingdom.

Of particular relevance to the Project are the Occupational Health Directorate and the Environmental Health Directorate. The Occupational Health Directorate is responsible for ensuring the safety of the work environment from pollutants and occupational hazards, in addition to the evaluation of the work environment. The Environmental Health Directorate is responsible for ensuring compliance with environmental health requirements and implementing the provisions of the Public Health Law through the relevant monitoring programs developed.

3.1.4 Ministry Of Labor (MOL)

MOL is the entity responsible for ensuring occupational health and safety, as well as providing the indoor air quality requirements that need to be complied with.

3.1.5 The Royal Society for the Conservation of Nature (RSCN)

RSCN is a non-profit, non-governmental organization that aims to conserve the Kingdom's natural resources. It is of particular relevance to the Project given the fact that the Project site has been designated as an Important Bird and Biodiversity Area (IBA).

4 DESCRIPTION OF THE PROPOSED PROJECT

4.1 Project Location

The project is located in Aqaba, approximately 330 km south of the capital Amman (Figure 4-1). The city has a 27-km coastline along the Gulf of Aqaba, which also is bordered by Saudi Arabia, Egypt and Israel.

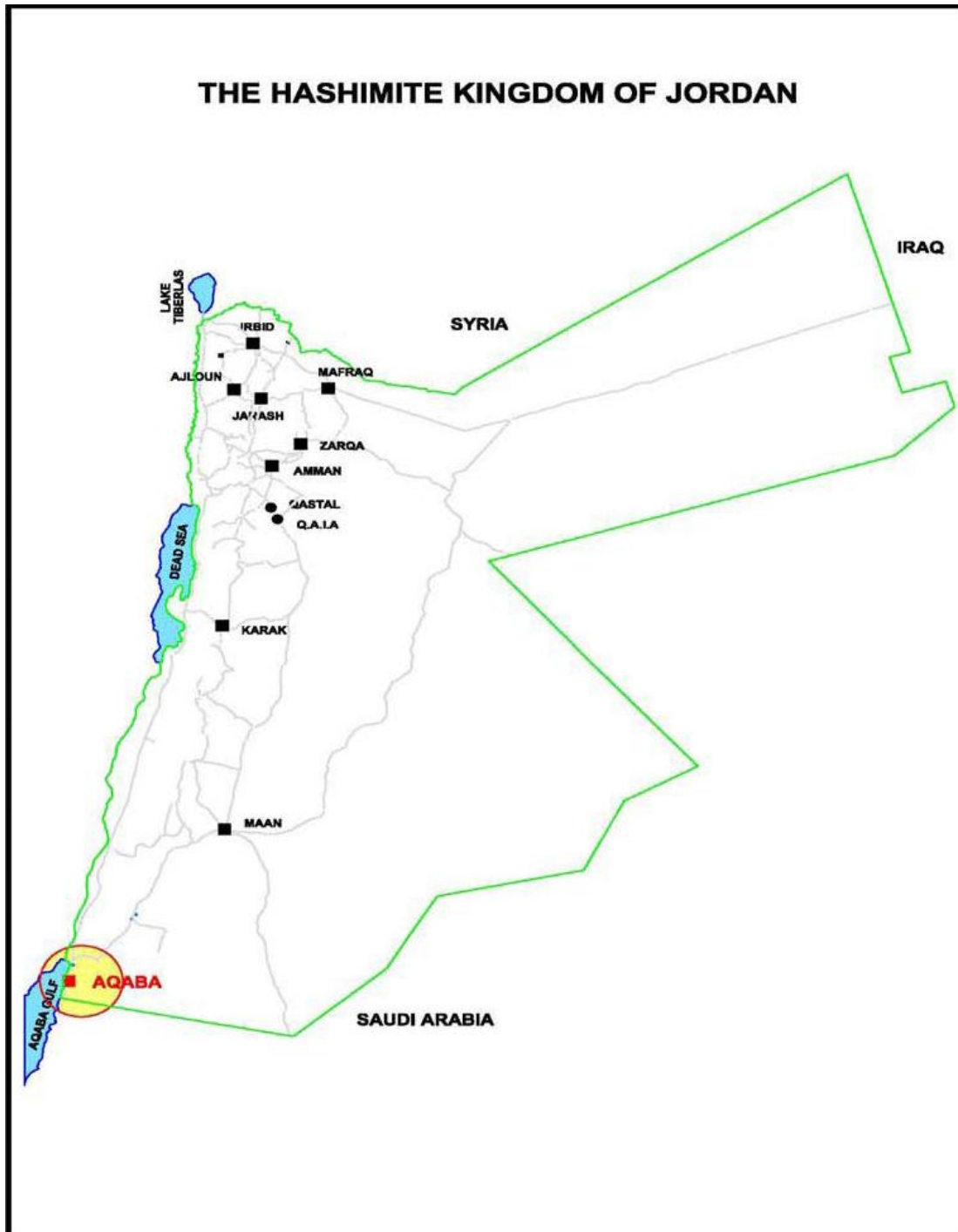


Figure 4-14-4: General Location of Aqaba

The Aqaba landfill site is located approximately 12 km south-southeast of the city of Aqaba, immediately adjacent to the base of the mountains. The location of the old and current landfill sites can be seen in Figure 4-2.

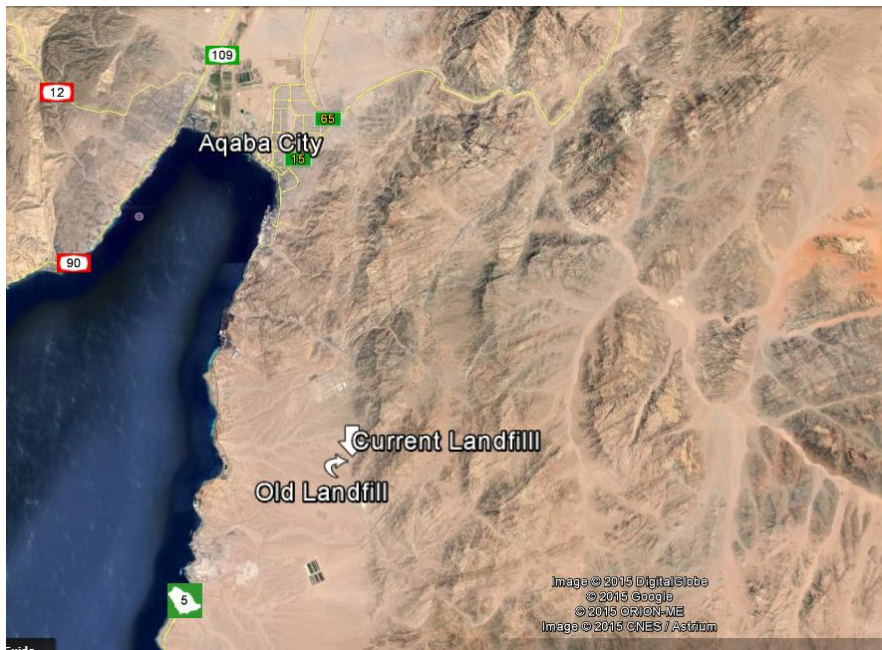


Figure 4-24-2: Current and Old Aqaba Landfill Sites

4.2 Project Objectives

The main objectives of the rehabilitation of the Aqaba waste disposal site are to:

- Design a lined sanitary landfill with engineered environmental controls to serve Aqaba for the coming 20 years.
- Develop a waste recycling management plan that is safe, feasible and suitable for the city of Aqaba.

4.3 Project Components

The proposed landfill design would incorporate the following constituents in order to minimize negative environmental and health impacts:

- Lined landfill cell
- Site access and control measures
- Material Recovery Area to replace current waste scavenging practices
- A complete and functioning landfill gas collection system
- A bottom liner and leachate control system
- A complete storm water management system and final cover

4.4 Existing Solid Waste Management Conditions

4.4.1 Waste Generation and Collection

The current municipal solid waste (MSW) generation rate in Aqaba Governorate is approximately 120 tons/day in summer and 85-100 tons/day in winter, for an average of approximately 1.3 kg/capita/day. MSW in Aqaba Governorate is collected by Clean City

Company through a public-private partnership contract signed with ASEZA. The contract covers Aqaba city (excluding the industrial area) and the towns of Qatar, Rahma, Rum, and Teten. MSW collected from Rum and Teten are disposed of in Qweira landfill¹.

4.4.2 Solid Waste Disposal

Municipal solid waste was first dumped at the old landfill site. However, in the 1980s the disposal operations were shifted further to the northeast where the current landfill is located. Figure 4-3 shows the remaining ashes from waste incineration in the old landfill site in addition to some scattered waste. It is clear that no proper decommissioning and rehabilitation of the old site was conducted by the operator.



Figure 4-3: Old Landfill Site (blackened piles)

The operation of the current site, which started approximately five years ago, was not the end of waste dumping as shown in Figure 4-4. The current site was not designed to be a sanitary landfill.

The waste, therefore, currently is being disposed of in an unlined landfill. Approximately 120,000 m² of land is now used for MSW disposal. In addition, the western portion of the site, where the old dumping site used to be, may contain methane-producing material.

In addition to being unlined, the landfill has no environmental controls at all; this practice has left the soil and air vulnerable to pollution and exposes landfill employees and users of the surrounding area to health risks. The lack of daily cover also raises concerns relating to vector breeding. Moreover, the site lacks proper fencing and security and poses a risk of landfill fires.

¹ Personal Communication with Khaled Qaisy-Clean City Company, Project Manager



Figure 4-4: Current Dumping Site

4.4.3 Waste Recycling

Current waste recycling practices at the site consist of a group of individuals picking recyclables directly from the freshly dumped waste in the landfill before it is compacted. This is clearly not an acceptable or effective method for recycling and exposes these individuals to health risks. Figure 4-5 shows the scavenged recyclables (mainly plastic and metals) collected in piles close to the temporary camp of those who collect them (Figure 4-6).



Figure 4-5: Scavenged Recyclables



Figure 4-6: Temporary Onsite Camp for Scavengers

An onsite contractor is responsible for recycling material found in the landfill, although occasional visits from scavengers who are not employed by the contractor have also been observed. Clean City Company segregates cartons in garbage. This includes offsite segregation, such as segregation in the backlots of big supermarkets that is shown in [Figure 4-7](#). The cartons can be then sold to the private sector to be re-exported to the neighboring Saudi Arabia.



Figure 4-7: Location of Carton Collection at Safeway Supermarket

4.5 Project Alternatives

After due consideration and evaluation of project alternatives, the following two alternatives remained as the main alternatives for further consideration by decision maker.

4.5.1 Alternative 1: No-Action Alternative

The first alternative is the No-Action Alternative, in which the following conditions will remain:

- Waste would continue to be dumped without any controls and would potentially contaminate the environment.
- Waste scavengers would continue to work unsupervised at the waste disposal site, exposing themselves to health hazards.

4.5.2 Alternative 2: Engineered Sanitary Landfill

A new landfill would be located at the old landfill site. The proposed design (see Figure 4-8) includes the following:

4.5.2.1 Access Control

Access to the site will be controlled by installing a security fence (minimum height 2,000 mm) with a barbed extension section around the entire site with lockable security gates to prevent unauthorized access. Additional fencing may be installed around interior facilities (blower/flare system, materials recovery area, fuel dispensary, etc.) in order to restrict access to specific personnel and to reduce potential theft and vandalism. Regular inspection of boundary, gate(s) and fencing must be conducted and damage should be immediately repaired. Additionally, proper facility signage must be permanently posted at the site entrance stating the name and purpose of the facility, the contact information for the responsible Owner/Operator, and the hours of operation.

4.5.2.2 Scale House and Landfill Management Building

In order to minimize construction costs, security responsibilities, and long-term O&M, a single facility is proposed for use as the Scale House and Landfill Management Building. The building will be of sufficient size to accommodate the weigh master, landfill management team, and landfill operators/laborers and the communications equipment, computers, offices, convenience and locker room facilities, and storage areas.

4.5.2.3 Vehicle Maintenance and Equipment Parking Area

The gravel-surfaced infrastructure area will be of sufficient size to securely accommodate parked construction/operation vehicles within the fenced facility boundary. A sloped concrete pad of sufficient size to accommodate the largest piece of equipment will be located within the infrastructure area with curbing along the perimeter of the pad. This pad will be utilized to contain potential spills during any required engine work, lubrication, or any fluids transfer (other than vehicle fueling) related to maintenance.

4.5.2.4 Materials Recovery Facility / Segregation Pad

An enclosed Materials Recovery Facility (MRF) within the infrastructure area is proposed. The MRF will generally consist of an enclosed building with a concrete tipping floor of sufficient size to accommodate the following: multiple (number to be determined) incoming waste hauling vehicles; maneuvering space for a wheeled loader to transfer tipped waste to the recovery area; materials handling/sorting equipment such as screens, magnets, conveyors, and crushers/compactors/balers; storage area(s) for separated recovered material; and a load-out area for loading vehicles with waste materials to be disposed of at the landfill and for loading recovered materials onto vehicles for transfer to end market users.

4.5.2.5 Fuel Dispensary

An above-ground equipment fuel dispensary (storage tank, manual or electrically operated fuel transfer pump, filling hoses) will be installed within the securely fenced area for use by

operations equipment and onsite vehicles. The storage tank will be located within a secondary containment berm or tank to contain potential leaks.

4.5.2.6 Leachate Storage/Evaporation Lagoon

A lined leachate storage/evaporation lagoon of sufficient capacity to store the design leachate production volume, with sufficient freeboard to contain precipitation, will be constructed within the infrastructure area adjacent to the site entrance. The 2-meter-deep lagoon has been designed with approximately 4,160 cubic meters (4,160,000 liters) of storage capacity from its invert to its crest, which exceeds the minimum storage requirements evaluated within the HELP Model leachate generation calculations and the storage capacity required for the largest open cell (Cell 2) in the event that a large storm event occurs when the cell is initially opened. The lagoon will receive pumped leachate from each landfill disposal cell through the HDPE force main.

For the Aqaba site, only passive/natural evaporation from exposure of the contained water surface to solar radiation and wind is proposed. No additional enhanced evaporation by hydraulic/mechanical means such as sprinklers, misters, or aerators is proposed. For added conservatism, evaporation of stored water *has not* been accounted for in leachate lagoon sizing.

The leachate lagoon will be lined with a base liner containment system equivalent to the landfill cells anchored at the lagoon crest and consisting of the following components in ascending order over the excavation/subgrade:

- 150 mm (minimum) of compacted select fill/liner cushion soil material
- Geosynthetic Clay Liner (GCL) with a maximum hydraulic conductivity of 5×10^{-9} cm/s
- 1.5mm (60mil) textured HDPE geomembrane liner
- Nonwoven geotextile cushion
- 450mm (minimum) thick granular drainage layer with a hydraulic conductivity of $\geq 1 \times 10^{-1}$ cm/s, functioning as a protective layer

4.5.2.7 Stormwater Management Basin

A stormwater management basin with sufficient capacity to contain the maximum anticipated run-on/run-off from the contributing landfill development area will be constructed within the infrastructure area adjacent to the site entrance. The basin storage capacity from its invert (elevation 359.3) to the invert elevation of contributing stormwater culverts (elevation 362.3) has been designed as 5,055 cubic meters (5,055,000 liters), which exceeds the minimum required 205.2 cubic meters (205,200 liters) estimated from the stormwater management calculations. Additional freeboard above elevation 362.3 has been provided to elevation 366 in order to facilitate continuity with surface grading of the adjacent infrastructure area and stormwater diversion channels.

4.5.2.8 Landfill Gas Management Facility

A 1,200-mm-diameter HDPE landfill gas condensate knockout will be located at the low point of the HDPE landfill gas header as it enters the infrastructure area. Condensate collected within the knockout will be drained via a 110-mm-diameter HDPE drain pipe to a buried condensate holding tank. Condensate will be periodically pumped out of the storage tank for off-site disposal. After the condensate management knockout, the landfill gas header will be routed to a blower/flare station for destruction of landfill gas in the infrastructure area adjacent to the site entrance.

[illegible]

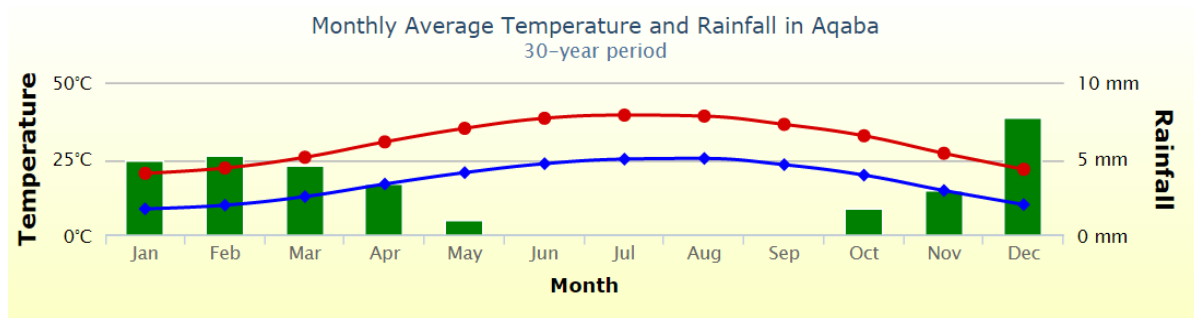
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5 DESCRIPTION OF THE STUDY AREA

This chapter describes the different aspects of the affected environment, commonly referred to as Baseline Conditions. Determination of the environmental baseline involves a description of conditions existing at present from which subsequent changes can be predicted and subsequently monitored and managed.

5.1 Climate

Aqaba city is characterized by a hot summer and warm winter. The prevailing wind, which is generally associated with dust, is northerly 10-20 kt.² Warm season at Aqaba lasts from May until the end of September. Figure 5-1 summarizes the monthly mean total rainfall, in addition to monthly minimum and maximum temperatures, over the past 30 years. The highest average temperatures were reported in July, reaching up to 39.4°C, and the lowest were in January, reaching 8.9°C (Table 5-1). The average annual temperature is approximately 24.2°C.



Source: World Meteorological Organization Website (<http://worldweather.wmo.int/en/home.html>)

Legend

—	Mean Minimum Temperature
—	Mean Maximum Temperature
■	Mean Total Rainfall

Figure 5-1: Monthly Average Temperature and Rainfall in Aqaba

Meteorological data for the parameters shown in Table 5-1 were obtained from the Aqaba Airport meteorological station, which is the nearest weather station to the study area.

Table 5-1: Climatic Information for Selected Months for Aqaba Airport Station

Parameter	January	April	July	October
Mean Maximum Temperature (°C)	20.5	30.7	39.4	32.7
Mean Minimum Temperature (°C)	8.9	17.0	25.1	19.9
Total Monthly Rainfall (mm)	4.9	3.4	0.0	1.8
Mean Relative Humidity (%)	58.0	41.3	38.3	50.5
Prevailing Wind Direction (degree)	002	353	355	002
Mean Wind Speed (Knots)	6.5	10.1	9.7	9.1

Source: Jordan Climatological Handbook / Jordan Meteorological Department, 2002

² Jordan Meteorological Department, Climatological Handbook, 2002

5.2 Geology and Soil

Most of the project area is covered with “Pleistocene gravels” deposits, except for the northeastern part where the site is covered by fill/waste materials (Figure 5-2). The general geology of the study area is represented by the following:

Quaternary Sediments (Pleistocene gravels)

Unsorted and poorly sorted sediments composed of sand with fragments of granitic rock derived from the adjacent mountains cover most of investigated site. These deposits consist mainly of angular poorly sorted gravels and sands with clasts of boulders to granular size set in a coarse-grained sand matrix adjacent to mountain sides and grading shoreward to fine beach sand.

Granitic Bedrock

Although granitic bedrock was not encountered in drilled boreholes, bedrock outcrops are located in the eastern side of the project area and form prodigious mountainous terrain that dominates the geology of the Aqaba area. This granitic bedrock is mainly composed of the Calc-alkaline granitoids and metamorphic rocks of the late Proterozoic Aqaba Complex and is represented by Yutum Granitic Suite and Rumman Granodioritic. Dyke rock of variable composition dramatically cross-cuts all of the granitoid units.

Structural Geology

The site area is located at the southern shore of the Gulf of Aqaba, a northeast extension of the Red Sea, which separates southeast Sinai from southwest Jordan and northwest Saudi Arabia.

The Gulf of Aqaba is an active structural rift with contributing boundary faults. These faults have an onshore morphological effect and are also interpreted to modify the submarine rift wall and control the local bathymetry of its descent. The regional structure is dominated by vertical to sub-vertical faults with predominant directions approximately N-S (N10° -15° E), E-W (N70° - 80° E) and NE-SW (N30° -40° E).

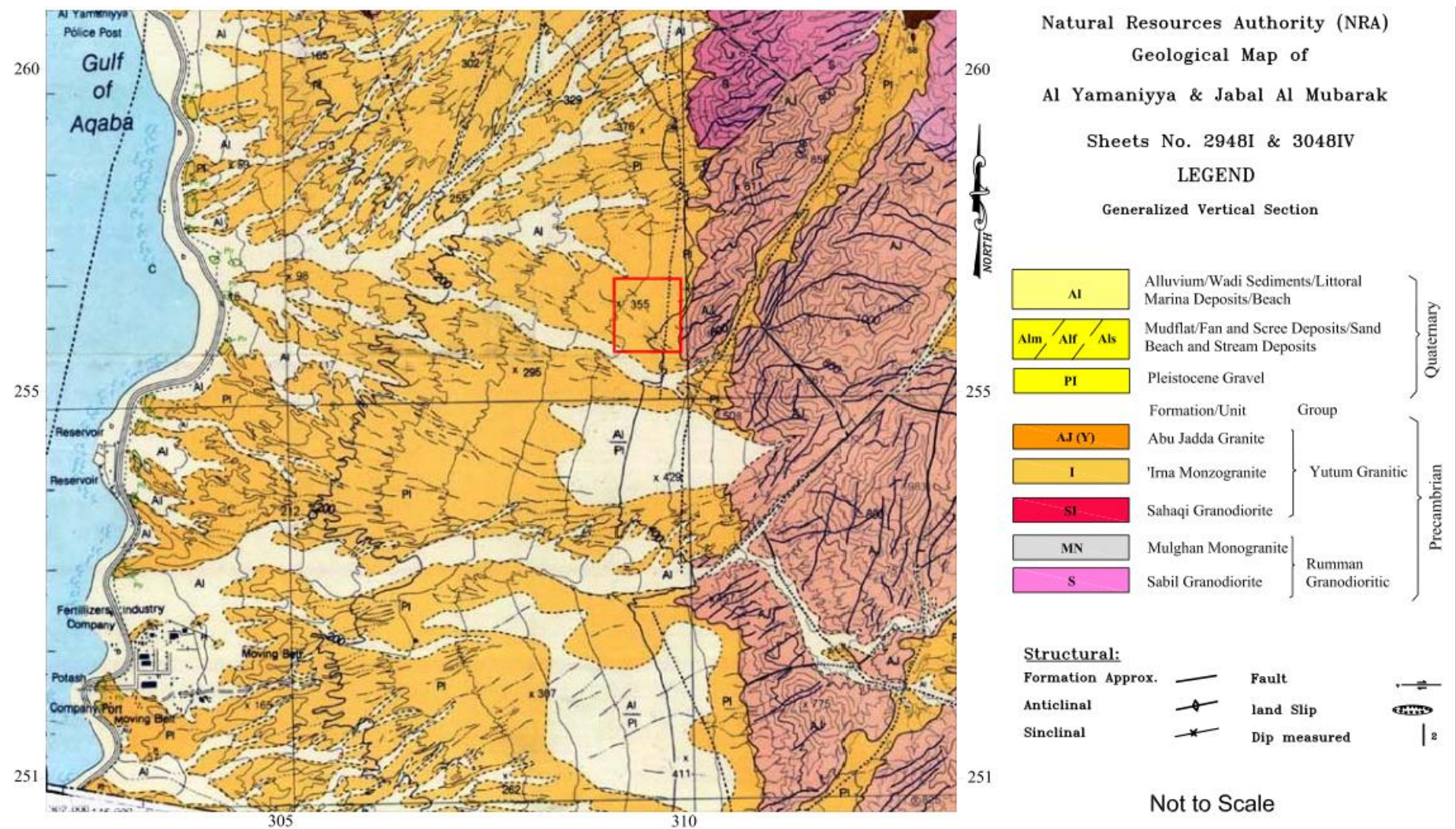


Figure 5-2: Geological Map of the Project Area

5.3 Topography

The project site terrain is relatively uneven and generally slopes to the west. The surface elevations range from approximately 315 m a.s.l to 340 m a.s.l (Figure 5-3).

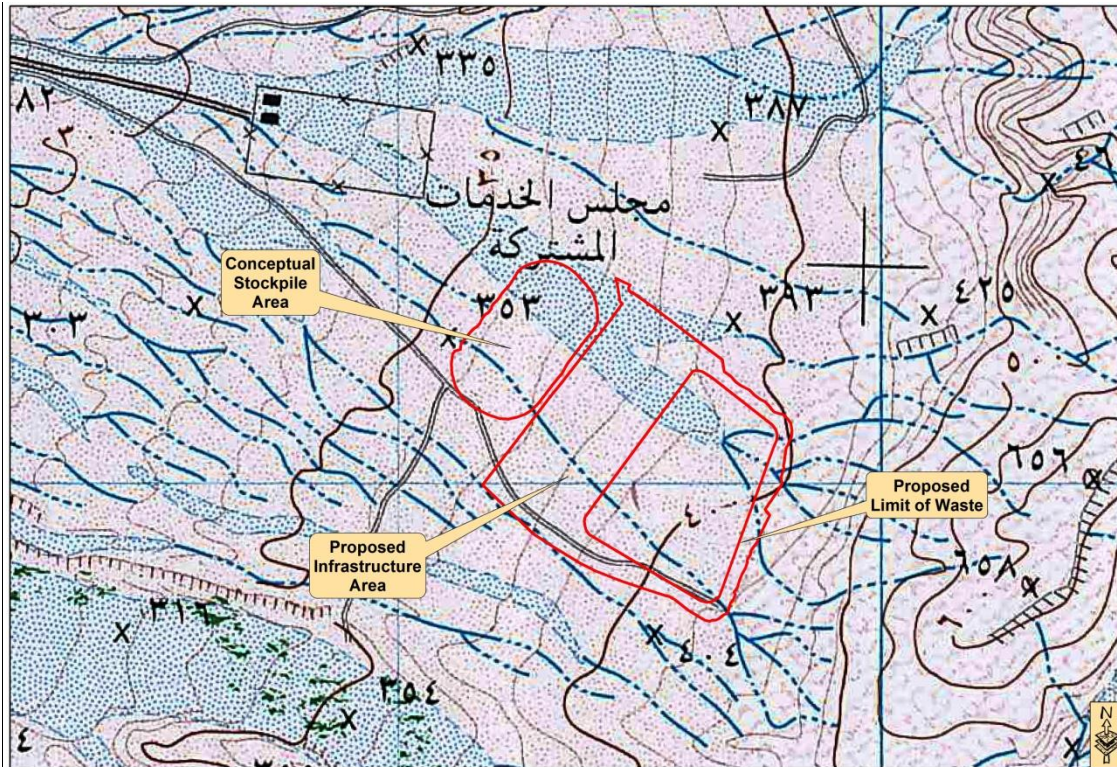


Figure 5-3: Topographic Map

Source: Royal Geographic Center, map of Wadi Shreeh, 2000

The site is also bordered to the east by mountain ridges, where limestone and rock are outcropping (Figure 5-4).



Figure 5-45-4: Terrain of the Project Site

5.4 Groundwater

According to geotechnical investigation for the project site done in January 2014, no groundwater or cavities were encountered at the drilled boreholes with depths ranging between 25m - 75m. The Disi-Mudawwara aquifer system is considered the major underground water source in Jordan. It extends from the southern edge of the Dead Sea in Jordan to the Tabuk region in Saudi Arabia (Figure 5-5). The total aquifer area is 308,000 km².³ The unconfined aquifer is considered a nonrenewable water source, due to the very low annual recharge rate which is estimated at approximately 3-10 MCM/year. Water abstraction from Disi aquifer first started in the 1970s. The current Disi aquifer abstraction levels exceed the sustainable limits whereby the abstraction is estimated by approximately 1,000 MCM/yr in Saudi Arabia and approximately 190 MCM/yr in Jordan. The two governments, Jordanian and Saudi, signed a non-binding memorandum of understanding (MoU) in 2007 prohibiting new production wells and the expansion of agricultural activities within 10 km along both sides of the border between the Dibdib/Dubaydib and Tabuk well fields. Jordan has recently started utilizing Disi aquifer to meet part of Amman drinking water demand through a conveyance. To maintain future sustainability of the aquifer for potable water, Jordan stopped large-scale agricultural irrigation using Disi water.

³ Gama Enerji Environmental and Social Review Summary (ESRS) ,2014
<http://www.gama.com.tr/doc/GAMA%20Enerji-ESRS.pdf> retrieved May 2015

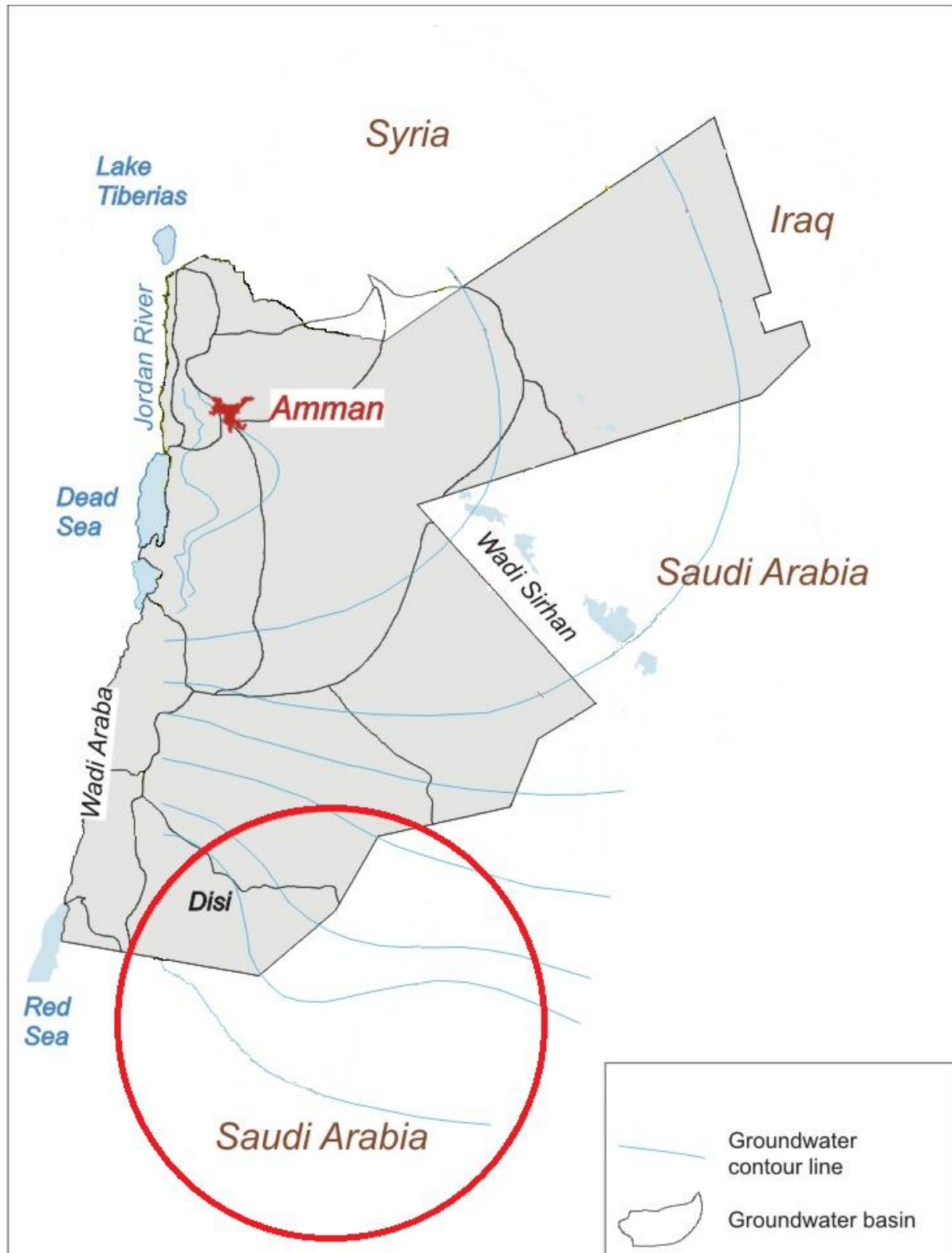


Figure 5-5 : Jordan Groundwater Basins with Special Emphasis on Disi Aquifer

Source : adapted from BGR, Groundwater basins and transboundary aspects in Jordan, retrieved May 2015 (http://www.bgr.bund.de/EN/Themen/Wasser/Bilder/Was_tz_jordan_gwmod_fig01_g_en.html)

5.5 Surface Water

There are two surface water basins near Aqaba: the Southern Wadi Araba Catchment and Wadi Yutum Catchment. The Southern Wadi Araba catchment area extends 75 km north of Aqaba, with a total area of 1,278 km² and precipitation of 50 to 150 mm/year in the

northeastern and southern parts, respectively. Potential evaporation is high, with rates ranging from 3,300 mm/year in the north to 4,100 mm/year in the south. The area contributes approximately 10 million m³/year of runoff to the Red Sea.

The Wadi Yutum catchment is located east of Aqaba, with an area of approximately 4,400 km². Precipitation is very low and ranges from 50 mm/year in the lowlands to 150 mm/year in the highlands. Potential evaporation is very high, ranging from 3,400 to 3,800 mm/year. The average annual rainwater is only 1.5 million m³/year which is low compared to the area of the catchment⁴.

The average annual precipitation in the project vicinity is not significant. Smaller, short duration storms have caused flooding that damage property and transmit sediment to the Gulf of Aqaba. Surface water catchment areas draining from outside the landfill development area into/onto the site (run-on) were identified and diversion channels and culverts could be designed to convey this surface water around the development area, bypassing the stormwater (runoff) management basin. The main run-on (water course) identified is from the mountain peak area to the east of the facility.

5.6 Unconventional Water Resources

Reclaimed water originating from treated effluent from the Aqaba Wastewater Treatment Plant (WWTP) is the main source of unconventional water in Aqaba, since no sea water desalination take place. Aqaba WWTP consists of two main treatment schemes: one primary and the other mechanical. The treated effluent of the primary WWTP is used for irrigation, whereas the effluent from the mechanical WWTP is used for city landscaping and industrial purposes (Table 5-2).

Table 5-2: Users and Quantities of Reclaimed Water from Aqaba WWTP

No.	Users	Land area (dunum)	Reclaimed Water (m ³ /day)
1	Al-Haq Palm Farm	650	1,950
2	Assalam agricultural project	250	750
3	ASEZA (landscaping)	580	1,740
4	Pilot Project for fodder and tree plantations	100	300
5	Phosphate Company (cooling)	-	4,500
Total		1,580	9,240

Regarding grey water, the only reported installed system in Aqaba is the one used in Intercontinental Hotel-Aqaba. None of the newly constructed hotels have installed a similar system. This can be attributed to the regular water supply in Aqaba and the relatively cheap prices of water.

5.7 Air Quality

As an economic, touristic and commercial hub, there are numerous sources of air pollution in Aqaba. The southern zone of Aqaba hosts industrial activities that contribute to air pollution.

⁴ Lipchin, C. Integrated Water Resources Management and Security in the Middle East, Published by The NATO Science for Peace and Security Programme, 2006

The power plant in this zone is a potential emitter of PCBs, mercury and acid gases, in addition to the conventional combustion air pollutants. Other sources are situated in the port. Activities such as loading and unloading, and fuel filling all emit pollutants into the air. Also, there are vehicular emission sources: cars, trucks, buses, and ships.

The project site is covered with sandy soil and has low vegetation cover; accordingly, wind blowing close to ground level increases particulate matter levels within the site area. Gases emitted from the current landfill site could not be estimated due to the lack of air quality monitoring onsite. The closest sensitive receptor is 4.5 km away from the site.

5.8 Noise

The industrial activities in the southern zone generate noise related to the operation of the plants in addition to the transportation of material and workers to and from the plants. In addition, ships getting into and leaving ports are another source of noise. However, the noise within the project site is localized since waste unloading and separation activities is done in an isolated area.

5.9 Flora and Fauna

Vegetation in Aqaba is characterized by tropical trees such as Christ's thorn jujube (*Ziziphus spina-christi*), in addition to shrubs and annual herbs. Some of the main floral species in Aqaba are *Acacia* species, desert date (*Balanites aegyptiaca*), giant milkweed (*Calotropis procera*), atil (*Maerua crassifolia*), toothbrush tree/mustard tree (*Salvadora persica*), white saxaul (*Haloxylon persicum*), and ochradenus (*Ochradenus baccatus*)⁵. The project area is located within the Sudanian bio-geographical zone in Jordan. The relative abundance of vegetation in this zone usually indicates shallow water table since this zone is characterized with very low rainfall (Figure 5-6). However, since the groundwater levels in the project site is not shallow, no vegetation was observed at the site except for areas near the water courses crossing the land adjacent to the site. Accordingly, the only flora species that was reported, near the border of the site, was *Acacia tortilis*. This may be due to the low rainfall and the disturbance in the site. Other flora species that were reported in the nearby proposed Aqaba Mountains Protected Area include: *Caralluma sinaica*, *Micromeria sinaica*, *Iphiona maris-mortoui* and *Acacia radianna*.

Aqaba landfill is approximately 5.5 km from the Aqaba Mountains proposed reserve and approximately 23 km from Wadi Rum Protected Area. However, as shown in Figure 5-7, the topography of the site creates a barrier between it and the two protected areas.

The current landfill is around 15 km away from the Aqaba Bird Observatory which is considered as part of the larger Aqaba IBA that includes the project site (Figure 5-8). Typically, landfill areas could attract certain avifauna species, such as ravens; however, during visits to the current landfill, ravens were hardly noticed.

⁵ General Corporation for Environment Protection (2000), *Plant Biodiversity and Taxonomy*, United Nations Environment Programme

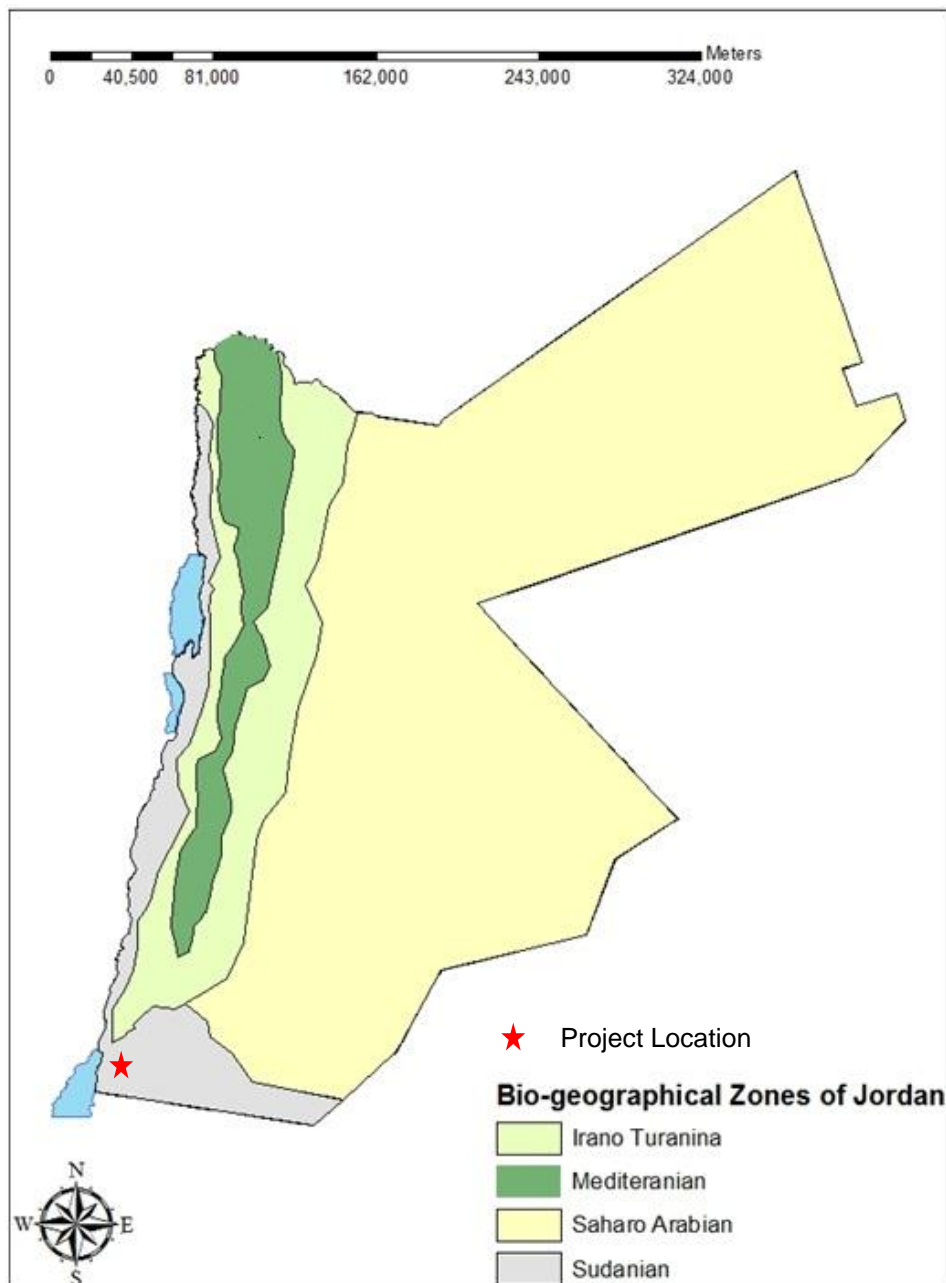


Figure 5-6: Project Location according to Bio-geographical Zones of Jordan

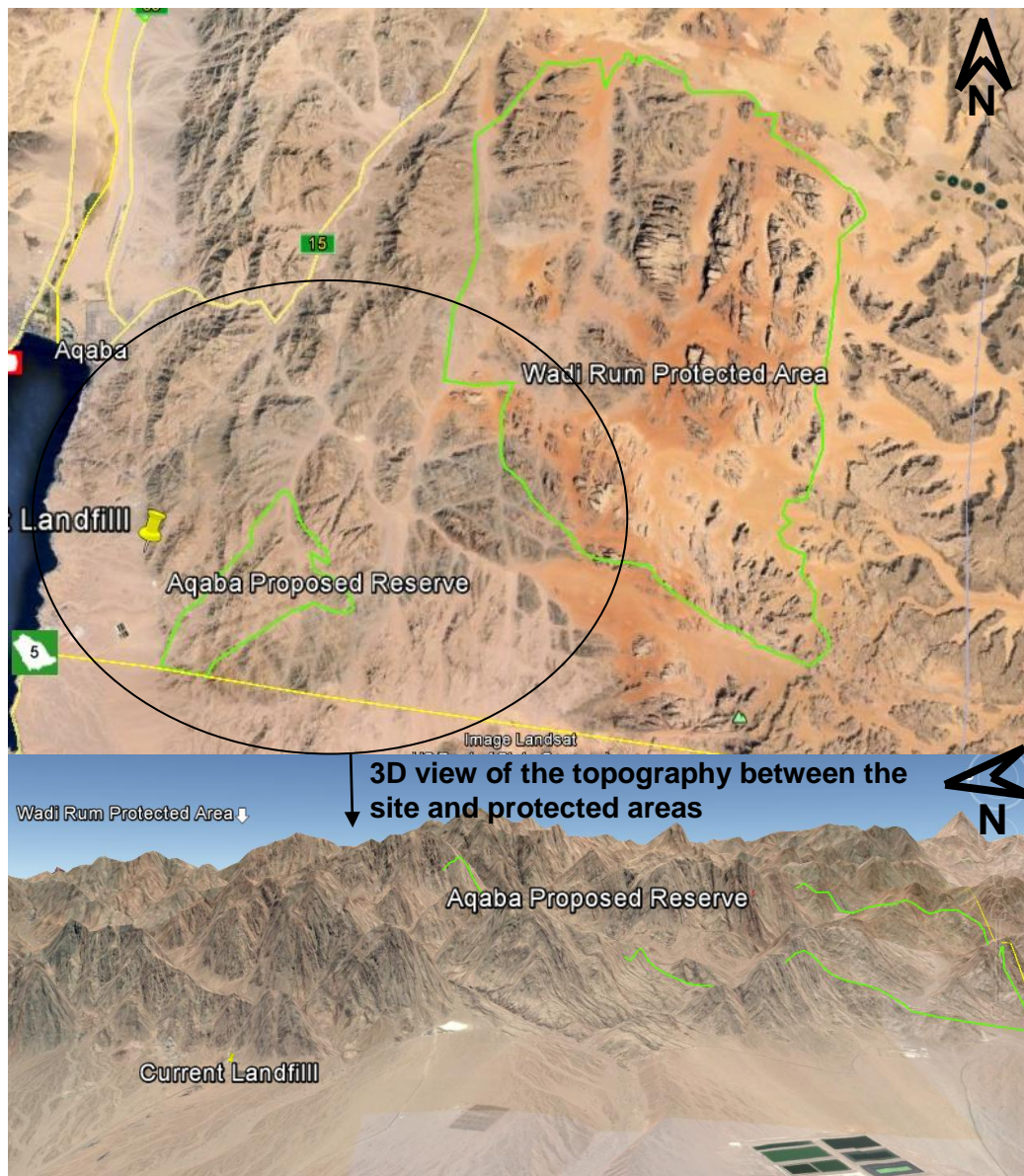


Figure 5-7: Landfill Site Relevant to Wadi Rum and Aqaba Proposed Reserve-with 3D View



Figure 5-8: Aqaba Important Bird Area (IBA)

Regarding other fauna species, Table 5-3 below describes the main fauna species that were reported in Aqaba Mountains Protected Area.

Table 5-3: Main Fauna found in Aqaba Mountains Protected Area

Scientific Name	Common Name	IUCN RedList Status*
<i>Vulpes cana</i>	Blanford's Fox	Least Concern
<i>Vulpes rueppellii</i>	Red Fox	Least Concern
<i>Felis silvestris</i>	Wild Cat	Least Concern
<i>Hyaena hyaena</i>	Striped Hyena	Near Threatened
<i>Canis lupus</i>	Syrian Wolf	Least Concern
<i>Caracal caracal</i>	Caracal	Least Concern
<i>Capra ibex nubiana</i>	Ibex	Vulnerable
<i>Varanus griseus</i>	Desert Monitor	Not Assessed
<i>Uromastix aegyptia</i>	Spiny tailed-Lizard	Vulnerable

Sources: 1. UNEP, UNDP & GEF Jordan Country Study on Biological Diversity, 2000
2. IUCN Red List website (www.iucnredlist.org), accessed May 2015.

5.10 Antiquities

Archaeological sites in Aqaba date back to 4000 BC, due to its strategic location at the trading junction between Asia, Africa, and Europe. The world's oldest known church is located in Aqaba, dating back to the late third century. The church had been unearthed by several archeologists and is now back-filled with earth for protection. The church is located east of Istiklal Street in the center of the city.

In the 12th century, the Crusaders had occupied an area of Aqaba where they built a fortress called Helim. The fort remains well-preserved until this day. It was rebuilt in the 14th century under the Mamluks and has been changed several times since then (Figure 5-9). The

Hashemite Coat of Arms is found above the main doorway. It was placed during the Great Arab Revolt of the First World War, when the Turks were driven out of Aqaba⁶.

Regarding the presence of archeological remains within the project site, a walkover of the project site and desk-based research have revealed that there are no archaeological sites in the immediate project area. However, the study team contacted the office of Department of Antiquities (DOA) in Aqaba and they cannot confirm that the old or the current landfill site were surveyed before their operation. Accordingly, the DOA office in Aqaba should be contacted in the implementation phase to confirm, based on specialized field survey, that the site is free of any archeological findings.



Figure 5-9: Aqaba Castle

5.11 Land Use

According to ASEZ Master Plan, the city of Aqaba (311.5 km²) is comprised of approximately 13.8% of built area and 86.2% vacant zoned areas. The distribution of zoning categories according to the Master Plan is shown in Table 5-4. The main activities that take place within these land uses are residential, industry and tourism.

Table 5-4: Zoning Categories of Aqaba

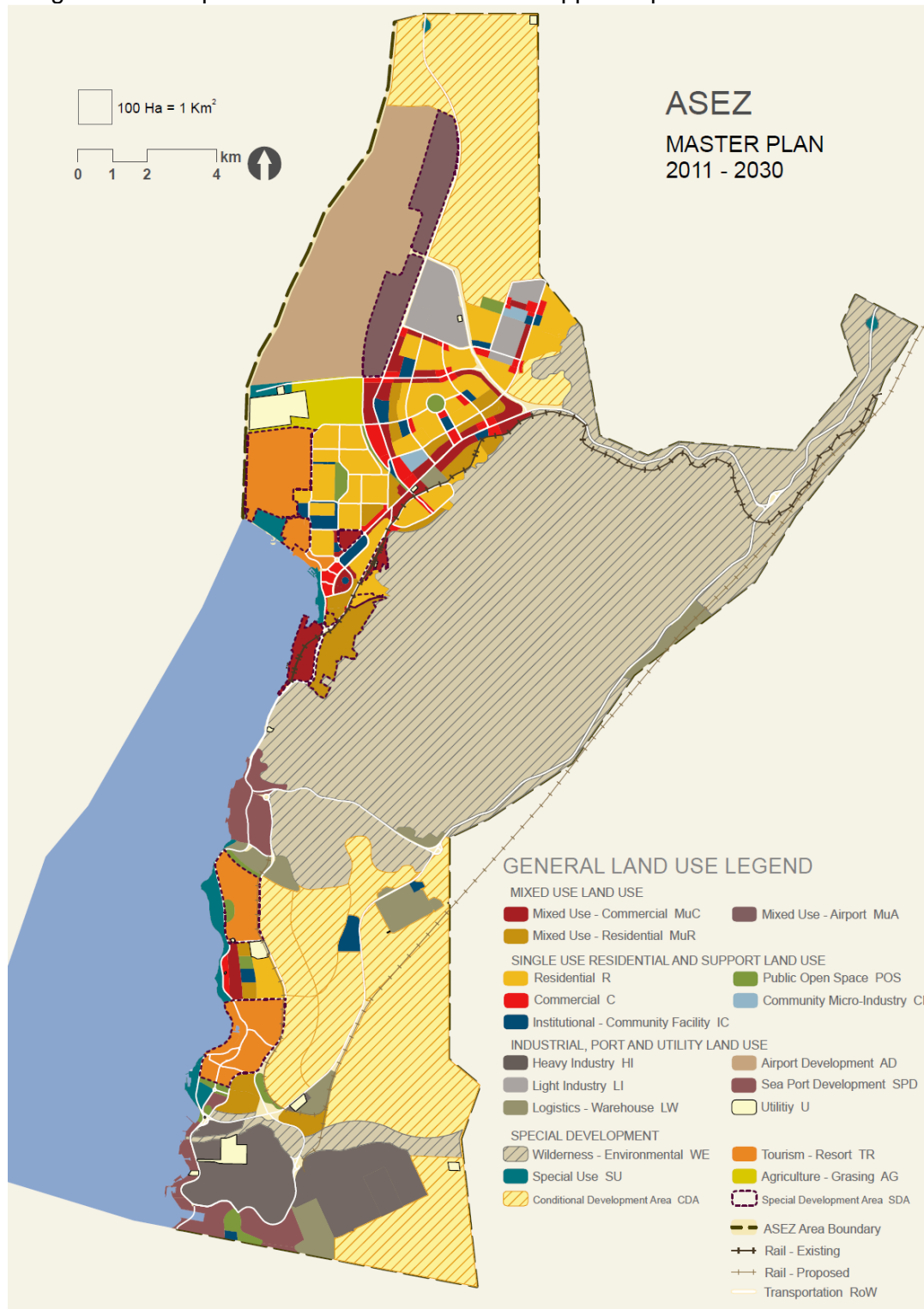
General Land Use Types	Area (km2)	%
Mixed Use Land Use	19.66	6.3
Single Use Residential & Support Land Use	24.10	7.7
Industry, Ports and Utility Land Use	61.09	19.6
Special Development Land Use	137.32	44.1
Conditional Development Area	68.95	22.2
Total	311.12	100%

Source: ASEZ Master Plan 2011 - 2030

According to the 2011-2030 Master Plan by ASEZ, land use in the project site and its vicinity are classified as a Conditional Development Area (CDA) (Figure 5-10), which is an area that

⁶ King Hussein Website (www.kinghussein.gov.jo)

is not designated for any growth during the 20-year planning period and is effectively a development reserve. However, Appendix A lists the conditions for approving developments within CDA which includes commitments made before 2011. The fact that the landfill pre-existed before 2011 could qualify it to be in this category. Accordingly, the feasibility of the design should be presented to ASEZ to start the approval process.



ASEZ MASTER PLAN 2011 - 2030 | ASEZA | AMMAN INSTITUTE

Figure 5-10: Land Use Map of Aqaba According to the ASEZ Master Plan 2011-2030

5.12 Population and Major Economic Activities

By the end of 2013, there were a total of 142,300 inhabitants at Aqaba Governorate, of which 79,200 are males. Population density is approximately 20.2 people/km², and average household size is approximately 5.5 persons / household. Aqaba Governorate is divided into several districts and sub-districts; population statistics per sub-district are detailed in Table 5-5.

Table 5-5: Population of Aqaba Governorate according to District and Sub-district, 2013

District	Sub-district	Population		
		Male	Female	Total
Aqaba	Aqaba	63,420	49,180	112,600
Aqaba	Wadi Araba	3,030	2,790	5,820
Quairah	Quairah	9,760	8,710	18,470
Quairah	Disi	2,990	2,420	5,410
Total		79,200	63,100	142,300

Source: DOS, Population according to Governorate, District, Sub-districts and Sex, 2013

Approximately 69.2% of inhabitants reside in apartments in Aqaba, while the remaining 30.8% reside in houses. However, the specific project area is far from residential areas and thus no inhabitants can be found within the vicinity.

Aqaba's geographical position has played an important role both in the city's foundation and development. As the only port in Jordan, Aqaba is vital to the Jordanian economy, attracting all sea imports and exports of the country. Aqaba hosts various industries that produce phosphate, cement, potash, and petrochemicals. In addition, Aqaba attracts many tourists every year, with many businesses in the city catering to tourist needs. Table 5-6 breaks down the percentage of workers by economic activity.

The unemployment rate of the Governorate of Aqaba is 15.2% (21.3% for females and 14.1% for males), which is higher than the national unemployment rate of 12.6%. The refined economic activity rate of Aqaba is 43.2% (14% for female and 69.7% for male), which is also higher than the Jordanian economic activity rate of 38% (14.1% for female and 69.7% for male)⁷. The poverty rate of Aqaba as of 2010 is 19.2%, which is about 5% higher than the national poverty rate of 14.4%.⁸

Benefiting from its location and status as Jordan's special economic zone, Aqaba's economy is based on the tourism and port industry sectors. The economic growth in Aqaba is higher than the average economic growth in the country. Under the special economic zone status, some investments and trades are exempt from taxation. As a result, new resorts, housing developments, and retail outlets are being constructed. New projects, such as Tala Bay and Saraya al Aqaba, will provide high-end vacation and residential homes to locals and foreigners.

⁷ DOS, Employment and Unemployment Survey, 2012

⁸ DOS, Poverty Survey, 2012

Table 5-6: Employed Persons Age 15+ in the Industry Sector for Year 2012 in Aqaba Governorate

Economic Activity	Percentage
Public Administration and Defense, Compulsory Social Security	22.9
Transportation and storage	22.4
Education	12.1
Wholesale and retail trade; repair of motor vehicles and motorcycles	9.6
Manufacturing	5.2
Electricity, gas, steam and air conditioning supply	5.1
Mining and quarrying	4.1
Accommodation and food service activities	3.8
Construction	3.6
Human health and social work activities	3
Other service activities	1.7
Administrative and support service activities	1.7
Agriculture, forestry and fishing	1.2
Information and communication	1.1
Financial and insurance activities	0.9
Arts, entertainment and recreation	0.4
Activities of households as employers; undifferentiated goods and services producing activities of households for own use	0.4
Water supply, sewage, waste management and remediation activities	0.3
Professional, scientific and technical activities	0.2
Activities of extraterritorial organizations and bodies	0.2
Real estate activities	0.1

Source: DOS, Employment and Unemployment Survey, 2012

5.13 Transportation

There are three main highways that connect Amman with Aqaba: the Desert Highway, the Dead Sea Highway and the Kings Highway. Details of the road network in Aqaba governorate are shown in Table 5-7 and Figure 5-11.

Table 5-7: Length of Road Networks by Type of Road, 2013

Type of Road	Length (Km)
Rural	78
Secondary	51
Highways	307
Total	436

Source: DOS Statistical Yearbook, 2013

The number of accidents in the governorate of Aqaba is significant, with 2,018 accidents registered in 2013. The rate of fatalities due to accidents in 2013 was approximately 2%, as

42 deaths occurred out of 2,018 accidents. Table 5-8 summarizes the type of vehicular accidents and the number of casualties in Aqaba.

Table 5-8: Number of Road Accidents, Type of Accident and Number of Casualties in the Governorate of Aqaba, 2013

Type of Accident	Number
Turnover	84
Car collision	1,850
Collision with pedestrians	84
Total	2,018
Injured/Dead	Number
Injured	528
Dead	42
Total	570

Source: DOS Statistical Yearbook, 2013

Aqaba Railway Corporation is responsible for monitoring railway network functions. The railway's main purpose is to transport phosphate and other goods to Aqaba harbor for export from Sheidiah mines in Ma'an Governorate.

With regards to the project location, it can be accessed via Aqaba back road which is an alternative road for heavy vehicles heading to the port. The access to the landfill is via a narrow two way asphalted road ([Figure 5-12](#)Figure 5-12).

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Figure 5-11: Road Network at Aqaba



Figure 5-12: Access Road to Project Location

5.14 Infrastructure (Water, Wastewater and Electricity)

The main source of water at households in Aqaba is the public network. This is also the main drinking water source; only 0.2% of residents use mineral water⁹. Aqaba Water Company manages, operates and maintains all water facilities in Aqaba, including 16 underground wells located in Disi district, approximately 906 km of water network, and several water reservoirs¹⁰.

The sewer network covers approximately 90% of the populated areas. Underserved areas include the container port, Tala Bay and the South Industrial Zone. These areas will keep using septic tanks until a wastewater network is constructed. The wastewater treatment plant was upgraded from a capacity of 10,000 m³ to 24,000m³ per day, with treated wastewater being used in landscaping, irrigation and industrial uses¹¹.

The existing electricity transmission grid is shown in Figure 5-13. Aqaba Thermal Power station consists of five steam units with a total capacity of 130MW, in addition to two hydraulic turbines with a total capacity of 6MW. The plant is characterized by high thermal efficiency due to the utilization of sea water in condensing steam issued from steam turbines¹².

⁹ Department of Statistics/ Household Expenditure & Income Survey 2010

¹⁰ Performance Management Unit Website, Ministry of Water and Irrigation

(<http://pmu.gov.jo/Home/AlMeyyahProgram/Commercialization/currentinitiatives/LLC/AqabaAWC.aspx>) accessed May, 2015

¹¹ Aqaba Development Cooperation Website

(http://www.adc.jo/Public/English.aspx?Lang=2&Site_ID=1&Page_ID=1877&Menu_ID=44&M_ID=4&M_Title) accessed May, 2015

¹² Central Electricity Generation Company Website (<http://www.cegco.com.jo/?q=en/node/207>) , accessed May 2015



Figure 5-13: Existing Electricity Transmission Grid

As for the project location, there is a potable water network along with an electricity transmission line. Wastewater is collected in a septic tank and emptied regularly.

5.15 Solid Waste

The current landfill receives 100% of Aqaba's domestic waste estimated to be around 120 tons of waste per day. According to a waste characterization survey conducted in Aqaba City for this project ([Figure 4-1](#)~~Figure 4-4~~), more than half of the waste samples (by weight) are of organic origin (mostly food waste). As for plastic waste, the percentage in general and PET plastic waste in specific, were the highest in commercial waste (21%) and (6%), respectively. However, HDPE plastic waste was significantly higher in residential areas (10%) than the rest of the samples. Paper waste percentages were the highest in hotels.

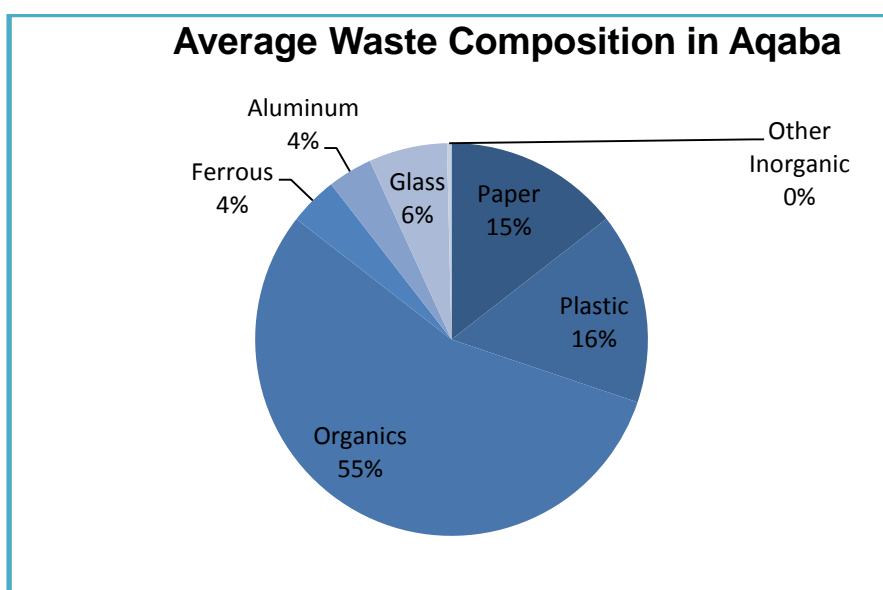


Figure 5-14: Overall results of waste characterization survey

The municipal cleaning contract for Aqaba City is estimated to be approximately 2.5 million Dinars per year.

5.16 Human Health

There are three hospitals in Aqaba Governorate with a total of 263 beds, along with 45 health centers varying from comprehensive to peripheral (Table 5-9). The closest hospital to the project area is Princess Haya Hospital (around 13.5 km) and the closest health center is Khazan Health Center (around 12 km).

Table 5-9 : Type and Number of Health Centers in Aqaba Governorate, 2013

Type of Center	Number
Comprehensive	3
Primary	9
Peripheral	12
Maternity	11
Dental Clinics	10
Total	45

Source: Ministry of Health Statistical Yearbook, 2013

The number of cases of diseases in the Governorate are detailed in Table 5-10; the percentage of cases in Aqaba Governorate relative to the total for the Kingdom of Jordan is small.

Table 5-10: Disease in Aqaba Health Directorate and in Jordan, 2013

Disease	Number of Cases in Aqaba	Total Number of Cases in Jordan	% of Cases in Aqaba Relative to Total in Jordan
Diarrhea	1,610	108,911	1.5
Pulmonary Tuberculosis	8	182	4.4
Brucellosis	8	158	5.1
Typhoid / Paratyphoid	0	4	0
Hepatitis A	1	1,082	0.1
Meningococcal Meningitis	0	2	0
Non-Meningococcal Meningitis	2	463	0.8
Measles	0	205	0
Mumps	2	136	1.5

Source: Ministry of Health Statistical Yearbook, 2013

6 INITIAL ASSESSMENT OF ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1 Impacts Associated with No-Action Alternative

The no action alternative entails that the existing landfill will remain operational in an inefficient manner and not according to Jordanian standards. This will be associated with high level of odor along with continuous emission generation. This will cause nuisance to operators and workers onsite along with neighboring areas. Additionally, the current waste separation which is done manually will jeopardize the health of workers onsite exposing them to pathogens and diseases.

6.2 Impacts Associated with Implementation of Project

6.2.1 Construction Phase

6.2.1.1 Geology and Soils

Anticipated Impacts

Site preparation and earthworks will potentially have localized impacts on soil and soil structure. However, the site is already contaminated with burned waste from the old landfill. Construction waste, waste concrete, and dust emissions have the potential to contaminate soil. Improper storage of chemicals and hazardous material, poor management of onsite temporary workshops, leakage from onsite sanitary facilities and improper management of fuels, oils, paints and hazardous chemicals could also lead to contamination of soil.

Excavation and grading as part of site preparation, as well as excavation for the cells and other landfill components, will slightly modify the topography.

Proposed Mitigation Measures

The construction corridor should be clearly marked and minimized to limit the extent of the affected area. The contractor should also minimize the vegetation clearance onsite and the movement of workers out of the construction area. Careful handling of already contaminated top soil will be required. Such contaminated soil should not be dumped near water courses. Excavated material should be used, where practicable, within the site to reduce construction waste. Disposal of contaminated soil and excess excavated material should be coordinated with current landfill operator. A list of all hazardous chemicals should be available in a designated area. Hazardous chemicals should be stored in a designated storage area that has impermeable surface, drip trays and spill kits to avoid and contain soil contamination. If storage of fuel on site is deemed necessary, liquid fuel, such as diesel, should be kept in double-walled storage tanks or contained within a suitably sized impermeable impoundment to avoid leakage into surrounding soils.

6.2.1.2 Surface Water and Groundwater

Anticipated Impacts

The sources of soil contamination mentioned above could potentially affect surface water and groundwater due to the wash of contaminants with runoff passing through the site or seepage of contaminants to the underground aquifer. Other potential sources of

contamination could include the improper disposal of site sewage from toilets, wash rooms and kitchen (e.g. from temporary offices and other facilities). In addition, washing of machinery onsite could potentially contribute to contamination of nearby water sources.

Proposed Mitigation Measures

The Contractor should manage and dispose of any construction effluent in a responsible manner. Sewage generated from onsite facilities should be collected through pipes into an underground impermeable septic tank, and the tanks should be emptied as needed.

Refuelling of construction machinery and vehicles should be done off site or in a designated area with properly designed fuel tanks and bunds. Effluent related to washing construction machinery and other vehicles should be discharged onto soil piles that will be disposed of after the end of construction period in coordination with ASEZA and current landfill operator. Another option would be to install an oil interceptor or trap prior to the onsite sewage system.

Good housekeeping practices will minimize the impacts caused by rainfall runoff on the project site. A proper drainage system should be designed to lead rainfall runoff out of the project site to the nearest culvert. Run-on intercepted from the mountain peak area to the east of the facility will be diverted around the landfill through lined diversion channels to the culvert near the connection of the paved entrance road to the landfill perimeter access road in the vicinity of the existing scavenger shacks. The culvert will discharge to diversion channel which will drain along the existing roadway to another culvert beneath the connection of the proposed paved site entrance road to the existing access road. No stockpiling or storage of waste or excavated soil should be allowed near the water course.

Surface water catchment areas draining from within the landfill development area and draining off of the site (run-off) were identified so that conveyance channels and culverts could be designed to convey this surface water to the stormwater (runoff) management basin.

6.2.1.3 Air Quality

Anticipated Impacts

Site grading and vegetation clearance, in addition to stockpiling during the construction phase, will generate dust and increased particulate matter (PM). Dust generated by the removal of burned topsoil in the old landfill could be of a toxic nature. However, since the sand within the project area is coarse grained, it is expected to settle within a short distance.

In addition, exhaust emissions from vehicles and diesel powered machinery will increase concentrations of NO₂. However, the northerly winds will help disperse such pollutants further to the south. Accordingly, the temporary impact on air quality would be considered less than significant.

Proposed Mitigation Measures

To reduce air quality impacts, the Contractor should apply good site management practices, including the following dust abatement measures:

- Moistening and water spraying of the excavation areas and all exposed surfaces two times daily to suppress dust. Exposed surfaces include, but are not limited to soil piles, graded areas, unpaved parking areas, staging areas, and access roads.
- Enclosing and covering of dusty material stockpile by impervious sheeting.

- Covering haul trucks transporting soil, sand, or other loose material to and from the site.
- Controlling movement on unpaved paths.

In addition, the contractor and all suppliers should be notified that use of old machinery with poor engine performance will be restricted. The contractor should minimize idling time either by shutting equipment off when not in use or reducing the time of idling to five minutes.

6.2.1.4 Noise

Anticipated Impacts

Noise caused by construction activities such as earthworks could add to the noise disturbance caused by waste vehicles unloading in the current landfill. Noise associated with construction activities is expected to last throughout the construction phase. The contractor is expected to work 6 days/week, with an average of 8 hours daily.

Noise levels will vary according to the activities executed and the combination of machinery used at the time. However, the main noise-causing activities onsite are expected to be site preparation activities, excavation activities and activities using heavy machinery.

Due to the distance from sensitive receptors and the topographic confinement of the site, such impacts will mainly affect construction workers and workers within the current landfill.

Proposed Mitigation Measures

Clause 5.5 in the Jordanian Noise Instructions restricts conducting noisy construction works between 8 pm and 6 am, except when approval is granted by the MoEnv. The mitigation measures recommended to reduce noise levels include the following:

- Provide workers onsite with hearing protection equipment
- Regular greasing of machinery.
- Where possible, incorporate low-noise systems, such as ventilation systems, pumps, generators, compressors and fans.
- Motorized equipment should be adequately muffled and maintained.
- Enclose the noise source, if possible.
- Whenever possible, schedule different noisy activities to occur at the same time, since additional sources of noise generally do not add a significant amount of noise. That is, less-frequent noisy activities would be less annoying than frequent less-noisy activities.

6.2.1.5 Flora and Fauna

Anticipated Impacts

The project area is already disturbed; however, the nearby water course could potentially support some species. Accordingly, construction activities could cause further degradation of the larger ecosystem and loss of some of the existing vegetation.

Proposed Mitigation Measures

Construction activities should be carefully planned so as to minimize the disturbance of flora, especially near the water course. Movement of workers, stockpiling and other construction

activities should be limited to the area within the construction corridor, which should be clearly marked during the mobilization stage. It is also recommended to limit construction activities during the breeding season of terrestrial fauna (March-June). Hunting onsite should be prohibited.

6.2.1.6 Population and Economic Activities

Anticipated Impacts

The execution of the proposed project will create new temporary job opportunities for unskilled workers during the construction phase (for a period of 18 months). Although a significant number of foreign workers are anticipated, the client should require the Contractor to prioritize hiring members of the local community. In addition, the larger community within Aqaba can benefit from supporting job opportunities, such as hiring of trucks and machinery and purchase and transport of construction material. Moreover, the construction personnel will slightly increase the demand for local services in Aqaba, such as health services and food supplies.

Proposed Mitigation Measures

Priority in hiring should be given to qualified locals in order to enhance the positive impacts on the local community in Aqaba. Once required jobs are identified, announcements can be advertised through ASEZ.

6.2.1.7 Water and Electricity Supply

Anticipated Impacts

During construction, a considerable amount of water will be required daily for construction activities such as concrete works and dampening the site after excavation. Supply of such quantities should be arranged with Aqaba Water Company. Conversely, the contractor can rent potable water tankers.

The temporary construction facility area and some construction activities will require electricity. Electricity connection to the site would need to be secured.

Proposed Mitigation Measures

The contractor should handle water resources efficiently and minimize water use during all construction activities.

6.2.1.8 Transportation

Anticipated Impacts

During the construction phase, vehicles transporting workers and trucks providing material into the site will join waste trucks coming into and out of the current landfill. This will in turn increase the traffic in the narrow access road. However, the main road leading to the site, Aqaba back road, is designed to be an alternative route for heavy vehicles. Thus disturbance in traffic flow outside the project premises is not expected.

On the other hand, improper transport of workers and traffic law violations may increase the risk of traffic accidents. In addition, dust generated from uncovered trucks delivering loose construction material might cause lower visibility for other road users.

Proposed Mitigation Measures

The contractor should prepare and abide by a traffic management plan suitable for the construction site conditions. The following mitigation measures should be included in this plan:

- Scheduling trips to the construction site should be done beforehand in coordination with the current landfill operator to avoid congestion in the narrow access road.
- Construction material should be securely packed and covered on trucks to prevent loads from falling off or generating dust.
- Workers should be transported in vehicles equipped with seats and barriers for their safety. It is not permitted to transport individuals in dump trucks.

6.2.1.9 Archaeological Resources

Anticipated Impacts

Although there are no known archaeological sites in the project area, the potential of encountering unknown sub-surface archaeology should be taken into consideration. In such cases, the Department of Antiquities (DOA) should be contacted to undertake a site inspection. Depending on the nature of the archaeological remains, the DOA may carry out an emergency excavation in order to fully record and document the remains.

Proposed Mitigation Measures

In the case of an archaeological chance find during construction, all excavations should be stopped and the DOA should be invited to assess the find and carry out an emergency excavation, if necessary. In the meantime, it is the responsibility of the Contractor to prevent looting of such findings until the DOA takes over the site.

6.2.1.10 Human Health

Anticipated Impacts

In the course of implementing any construction activity, workers are subject to several hazards associated with the misuse and/or malfunctioning of heavy machinery, cave-ins, prolonged exposure to the sun, dust and noise. Even negligence in the implementation of good housekeeping measures at the site can pose a health and safety risk. In addition, the risk of fire starting in the uncovered waste piles in the adjacent landfill should be considered in the occupational health and safety plan.

The project is located in a remote area away from residential areas; however, construction activities could also pose health and safety hazards to scavengers working in the current landfill if they trespass the construction area.

Proposed Mitigation Measures

The Contractor and landfill operators should be responsible for the health and safety of all onsite personnel. A Health & Safety (H&S) Plan should be prepared by the Contractor and

communicated with the landfill operators prior to commencement of any construction activities onsite. Site access should be limited to construction personnel to minimize the chances of accidents.

Construction personnel should receive H&S training after being provided with Personal Protection Equipment (PPE), which they will be required to use as necessary. The Contractor should also establish and enforce hygienic conditions at canteens and washing facilities on the project site.

6.2.1.11 Solid Waste

Anticipated Impacts

Waste will be generated due to construction activities and by workers on the site during construction. Waste generated during construction can be disposed of in the adjacent current landfill after coordinating with the landfill operator.

Proposed Mitigation Measures

The contractor should prepare a solid waste management plan after coordinating with ASEZA and current landfill operators to discuss the potential to use the current site for final disposal of municipal and construction waste.

6.2.2 Operation Phase

6.2.2.1 Topography, Geology, and Soil

Anticipated Impacts

Soil contamination could take place if leachate leakage occurs due to lining rupture, or in case of malfunction in the leachate collecting system. Additional sources of soil contamination include oil and fuel leakage from machines and vehicles onsite as well as waste from workers onsite. Movement of vehicles transporting waste to and from the site might have an adverse impact on soil stability. There is no anticipated impact on topography and geology of the area during operation.

Proposed Mitigation Measures

The leachate lagoon will be lined with a base liner containment system equivalent to the landfill cells anchored at the lagoon crest. The possibility of soil contamination by leachate is therefore minimal. Nevertheless, proper maintenance and monitoring is advisable. Maintenance and fueling of vehicles should take place on sealed floors, and leaking accidents should be reported and dealt with immediately using spill kits along with removing the top contaminated soil. Waste (both solid and liquid) should be collected regularly and disposed of in an appropriate manner. A Soil Erosion Prevention Plan and Spill Management Plan should be prepared and abided by.

6.2.2.2 Surface Water and Groundwater

Anticipated Impacts

Potential impacts include water and soil contamination by leachate leaking, in addition to water being contaminated by wastewater or waste generated by workers onsite.

Proposed Mitigation Measures

Waste should be continuously covered and compacted. Leachate will be collected in a lined lagoon, which should be regularly monitored and maintained. A stormwater management basin with sufficient capacity to contain the maximum anticipated run-on/run-off from the contributing landfill development area will be constructed within the infrastructure area adjacent to the site entrance.

Operator should prepare and abide by soil erosion prevention plan and spill management plan. Parking onsite should be of impermeable surface and all fueling and maintenance procedures should take place in designated area.

6.2.2.3 Air Quality

Anticipated Impacts

Decomposition of organic matter within the landfill will produce gases, especially methane, which is toxic and highly flammable. Odor onsite, either from the decomposition of waste or from leachate, will cause nuisance to operators onsite. Air quality might also be affected negatively by the increased dust levels and emissions generated by the vehicles transporting waste to and from the site.

Proposed Mitigation Measures

The design of the landfill includes a gas management system in addition to leachate collection and treatment system, which will reduce the impact on air quality. These systems should be maintained continuously and, in case of emergency, excess amounts of gas should be collected and vented properly. The whole system should include proper ventilation. The leachate collection system should also be regularly maintained to reduce generated odor. Covering waste should be done on a daily basis, which will help reduce emissions released to the atmosphere. Vehicles onsite should use marked, paved lanes and avoid using un-asphalted roadways. Additionally, all vehicles should be maintained to verify they are in good working condition.

6.2.2.4 Noise

Anticipated Impacts

Noise will be generated onsite due to the movement of vehicles transporting waste from and to the site, along with noise generated from separation machines that will be operational onsite.

Proposed Mitigation Measures

All equipment should be well maintained and, in case of elevated noise levels, workers onsite should be provided with hearing protective gear.

6.2.2.5 Flora and Fauna

Anticipated Impacts

Some animals or birds might be found around the site scavenging for food. The movement of vehicles from and to the site might scare and harm small animals, additionally, noise generated through the movement of vehicles and operational procedures onsite might disturb birds around the area.

Proposed Mitigation Measures

The landfill should be operated properly and waste should be covered on daily basis. Fencing around the site will also aid in preventing animals from entering the site and from being harmed by the machinery operating onsite.

6.2.2.6 Population and Major Economic Activities

Anticipated Impacts

During the operation of the new landfill, a material recovery unit will be installed. Positive impacts are anticipated, as the efficiency of separation and recycling will be higher and workers will not have to handle waste directly. However, socio-economic impacts may occur, as the number of workers onsite (scavengers) may be reduced and a source of income subsequently lost.

Proposed Mitigation Measures

Operators and scavengers onsite should be informed properly, prior to the start of proposed project activities, of the possibility to remain working onsite or not.

6.2.2.7 Transportation / Traffic

Anticipated Impacts

The main users of the road are vehicles transporting waste, estimated to be around 30 loads per day, and workers onsite. The operation of the MRF will not affect the number of vehicles entering the site but may decrease the number of workers who collect and separate waste onsite.

Proposed Mitigation Measures

Proper signs should be distributed along the road and at the entrance point from the main road. Maintenance of the asphalt might be needed after construction activities are completed, which will positively impact the safety of road users.

6.2.2.8 Human Health

Anticipated Impacts

There is always an inherent health hazard when working with waste: pathogens and contaminants can pose a health risk to workers onsite. Increased exposure to methane gas might also cause some respiratory diseases. Additionally, workers operating near heavy

machinery might be susceptible to accidents if no precautionary measures are implemented or machinery is not well maintained and operated.

Proposed Mitigation Measures

Generally, the new landfill will be operated according to Jordanian standards: all waste will be compacted and covered regularly, and the presence of a material recovery unit will help minimize the direct contact of workers onsite with waste, thus reducing the possibility of diseases. A comprehensive Health and Safety Plan (HASP) should be prepared and abided by during the operation phase. Workers onsite should also be provided with PPE.

Operators and workers onsite should be provided with a proper training on the operation of the new landfill. In addition, safety awareness sessions should be held regularly for workers onsite. The location of the nearest hospital or health center should be identified and communicated to all personnel onsite. Access by un-authorized personnel should be limited through the use of fencing, gates, and signage.

7 INITIAL ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

This environmental management and monitoring plan (EMMP) provides the tools for adequate implementation of the proposed mitigation measures so that potential negative impacts are minimized. It also spells out special monitoring requirements in detail and assigns responsibilities for implementation and monitoring. This EMMP will help the executing agency and the concerned authorities to address the adverse environmental impacts of the project, enhance project benefits, and introduce standards of good environmental practice.

The primary objectives of the EMMP are to:

- Address the environmental consequences resulting from the activities performed during construction and operation periods of the project
- Facilitate the implementation of the mitigation measures identified in the ECR by providing the technical details of each project impact, and providing an implementation schedule
- Define a monitoring mechanism and identify monitoring parameters to verify that all mitigation measures are completely and effectively implemented
- Identify training requirements at various levels and provide a plan for implementation

This section of the report explains mitigation measures to eliminate or minimize the potential negative environmental effects caused by the activities carried out during the construction and operation phases of the project. A monitoring plan will be used to monitor the environmental effects of the project. However, once an alternative is selected and a more detailed environmental study of the preferred option is under way, a more detailed EMMP should be prepared. This construction section of the EMMP would form part of the tender documents that the Contractor should abide by, while the operation section will be provided to the operator of the landfill.

7.1 Proposed Mitigation Measures

The development of the project will result in potential negative environmental impacts that are likely to occur during the construction and operation phases.

During the construction phase, some of the main potential negative environmental impacts associated with implementation of the project include:

- Localized impacts on soil contamination
- Increased potential of surface water contamination
- Increase in dust and noise
- Occupation health and safety hazards

During operation, potential negative environment impacts include:

- Localized impacts on soil contamination
- Adverse impact on air quality
- Adverse socio-economic impact on workers onsite

Table 7-1 and Table 7-2 detail the EMMP that should be implemented during both the construction and operation phases.

Table 7-1: EMMP during Construction Phase

Impact/ Issue	Mitigation Measure	Monitoring Measure	Implementation Responsibility	Supervision Responsibility
Soil contamination and loss of soil structure	Minimize the size of the construction corridor	—	Contractor	ASEZA
	Minimize onsite vegetation clearance			
	Limit the movement of workers outside of the construction area			
	Use excavated material onsite whenever applicable			
	Carefully handle previously contaminated topsoil			
	Equip chemical storage area with drip trays, impermeable floor and spill kits			
	Prepare a list of all hazardous chemicals onsite			
	Keep fuel and oil in double-walled storage tanks or within a suitably sized impermeable bund			
Surface water and groundwater contamination	Collect sewage generated from onsite facilities in an impermeable septic tank and empty it as needed	—	Contractor	ASEZA
	Refuel construction machinery and vehicles in a designated area			
	Discharge wastewater from washing construction machinery and other vehicles into soil piles and cap them, or dispose in the onsite sewage system after installing an oil interceptor			
	Design a proper drainage system to lead treated runoff out of the project site to the nearest wadi			
	Prevent stockpiling or storage of waste or excavated soil near the water course			
Air Quality (increased dust and NO ₂)	Spray excavation areas and all exposed surfaces with water two times daily to suppress dust	Collect samples of ambient air quality for PM ₁₀ , PM _{2.5} and NO ₂ and compare compliance with Jordanian Ambient Air	Contractor	ASEZA
	Enclose and cover dusty material stockpile with impervious sheeting			
	Minimize idling time for machinery either by shutting equipment off when not in use or reducing the time of idling to five minutes			

USAID Water Reuse and Environmental Conservation Project
Environmental Considerations Report for Aqaba Waste Management and Landfill Design Report

Impact/ Issue	Mitigation Measure	Monitoring Measure	Implementation Responsibility	Supervision Responsibility
	Cover haul trucks transporting soil, sand, or other loose material to and from the site	Quality Standards (JS: 1140/2006)		
	Control foot traffic and vehicular travel on unpaved paths and roadways			
Noise	Regularly grease machinery	Collect noise level measurements during scheduled noisy activities and compare results with Jordanian Guidelines for Prevention of Noise (2003)	Contractor	ASEZA
	Muffle and maintain motorized equipment			
	Enclose the noise source, if possible			
	Provide workers with hearing protection gear			
	Schedule different noisy activities to occur at the same time			
Flora and Fauna	Limit movement of laborers and construction activities to within the construction corridor	—	Contractor	ASEZA/ RSCN
	Limit construction activities during the breeding season of terrestrial fauna (March-June).			
Archaeological Resources	Prepare chance find procedure	—	Contractor	ASEZA
	In the case of an archaeological chance find, all excavations should be stopped and the DOA should be invited to assess the find and to carry out an emergency excavation, if necessary			
	Protect findings to prevent looting until DOA takes over the site			
Population and Economic Activities	Priority in hiring should be given to qualified locals	—	Contractor	ASEZA
	Advertise jobs in ASEZA before the start of the project			
Transportation	Schedule trips to the construction site in coordination with the current landfill operator	—	Contractor	ASEZA / Local Traffic Department / Current landfill operator
	Securely pack and cover construction material on trucks			
	Transport laborers in vehicles equipped with seats and barriers for their safety			

USAID Water Reuse and Environmental Conservation Project
Environmental Considerations Report for Aqaba Waste Management and Landfill Design Report

Impact/ Issue	Mitigation Measure	Monitoring Measure	Implementation Responsibility	Supervision Responsibility
Water Supply	Handle water resources efficiently and minimize water use during all construction activities	—	Contractor	ASEZA /AWC
Human Health	Prepare H&S Plan and communicate it with the landfill operators prior to commencement of construction	Hire an H&S officer to oversee the implementation of the H&S plan	Contractor	ASEZA/ Current landfill operator
	Limit site access to construction personnel only			
	Provide construction personnel with H&S training			
	Provide construction personnel with PPE as necessary			
	Establish and enforce hygienic conditions at canteens and washing facilities			
Solid Waste	Prepare a solid waste management plan	—	Contractor	ASEZA/ Current landfill operator
	Coordinate with ASEZA and current landfill operators to use the current facility for final disposal of municipal and construction waste			

USAID Water Reuse and Environmental Conservation Project
Environmental Considerations Report for Aqaba Waste Management and Landfill Design Report

Table 7-2: EMMP during Operation Phase

Impact/ Issue	Mitigation Measure	Monitoring Measure	Implementation Responsibility	Supervision Responsibility
Soil Contamination	Prepare and abide by a soil erosion prevention plan	Perform soil contamination tests	Operator/Third Party Assessor	ASEZA
	Prepare and abide by a spill management plan			
	Designate a fuelling and maintenance area			
	Confine vehicle traffic to clear designated roadways			
	Restrict solid waste disposal to lined landfill cells			
Air Quality	Regularly maintain the leachate collection system	Perform regular air quality testing	Operator/Third Party Assessor	ASEZA
	Regularly maintain the gas management system			
	Cover waste on a daily basis			
	Perform regular maintenance to vehicles onsite			
	Avoid using un-asphalted roads			
Groundwater Contamination	Monitor groundwater quality in the project area regularly	Monitor water quality	Operator/Third Party Assessor	MWI ASEZA
	Prepare and abide by a soil erosion prevention plan			
	Confine solid waste disposal to the designated landfill cells			
	Prepare and abide by a spill management plan			
	Designate a fueling and maintenance area			
	Provide a parking site paved with an impermeable surface			
	Install and maintain a run-off draining channel			
	Maintain and monitor the installed leachate collection system and evaporation pond			
	Enforce proper waste compaction and cover practices			
Human Health	Prepare and abide by health and safety plan	Perform regular health check for operators onsite	Operator/Third Party Assessor	ASEZA
	Cover and compact waste regularly			
	Provide workers with training on proper operating procedures			
	Provide workers onsite with PPE			
	Identify the nearest hospital / health center and communicate it workers onsite			
	Limit access by un-authorized personnel			
	Conduct regular safety awareness sessions			
Noise	Perform regular maintenance for the equipment	Perform noise monitoring	Operator/Third Party Assessor	ASEZA
	Provide workers onsite with hearing protective gear			

USAID Water Reuse and Environmental Conservation Project
Environmental Considerations Report for Aqaba Waste Management and Landfill Design Report

Flora and Fauna	Cover waste on daily basis.	-	Operator/Third Party Assessor	ASEZA
	Fence the site to prevent animals from entering the site and from being harmed by the machinery operating onsite			
Population and Major Economic Activities	Inform operators and workers currently onsite wither they will remain working or not before hand	-	Operator/Third Party Assessor	ASEZA
Transportation / Traffic	Distribute signs along the road and at the entrance point from the main road.	-	Operator/Third Party Assessor	ASEZA / Traffic Department

8 PROPOSED ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY AND SCHEDULE

8.1 Literature and Data Review

If the decision is made to implement the proposed project, an EIA should be prepared in compliance with the Regulation for Protection of the Environment in ASEZ (No. 21 for 2001) and USAID's Environmental Compliance Procedures (Title 22, Code of Federal Regulations, Part 216); and consistent with the requirements of any lending organization that provides financing for the project. The contractor should hire a qualified consulting entity to conduct the EIA study. The consulting entity shall conduct field investigations, desktop research and consult with experts, when required, in order to efficiently assess the existing environment and address any significant environmental impacts related to this project.

The EIA team shall review all available data about the project area, which will include review of studies and investigations related to the existing disposal facility and of all available reports on Aqaba Landfill.

Data will be collected by reviewing several pertinent documents, including but not limited to the following:

- Aqaba Landfill design report
- Data from the Department of Statistics publications
- Jordan Climatological Handbooks and Bulletin
- Site geotechnical investigation report
- Jordan Country Study on Biological Diversity, Mammals of Jordan and Plant Biodiversity and Taxonomy

8.2 Field Investigations

Data shall be collected first hand through several field visits to the project site. Field investigations, including "walk" surveys, should be conducted during the preparation of the EIA document to acquire a comprehensive understanding of the environmental conditions at the site. During the investigations, the potential impacts on the project site area should be considered and mitigation measures to be implemented during the construction and operation phases of the project should be proposed.

8.2.1 Surface Water and Groundwater Assessment

A field survey should be undertaken to verify details of the existing surface water discharge in the area, and identify the main recharge zones in the project area. Where feasible, water samples from nearby surface water and groundwater sources should be collected to establish the baseline conditions for comparison with the concentration of elements which may be associated with project activities.

In addition, routing and direction of groundwater flows should also be assessed in order to evaluate the impacts of the proposed project on the groundwater and to identify any potential wastewater run-off issues.

Moreover, the study should include impacts on surface water and groundwater quality from project activities, such as waste dumps and leachates. It should also recommend mitigation measures to be implemented to protect water resources in the project area.

The study should also assess water needs for the different project activities and develop a “Water Management Plan”.

8.2.2 Air Quality and Noise Baseline Study

Dust emissions and noise level during construction period should be assessed qualitatively.

In order to establish a baseline for the concentrations of air pollutants and noise levels, air quality testing shall be carried out. Sampling should be conducted at several testing points inside and outside the disposal facility boundaries. In addition to noise, key parameters that should be tested include:

- Sulphur Dioxide (SO₂);
- Methane (CH₄)
- Hydrogen Sulfide (H₂S) ;
- Nitrogen Dioxide (NO₂);
- Ozone (O₃);
- Carbon Monoxide (CO);
- Carbon Dioxide (CO₂);
- Ammonia (NH₃);
- Total Suspended Particles (TSP); and
- Particulate matter (PM₁₀, PM_{2.5}).

Samples should be collected and analyzed according to the JS 1140/2006 Ambient Air Quality Standards (daily and hourly measurements). Odors inside the facility should also be assessed and monitored regularly.

8.2.3 Ecological Assessment

An ecologist shall conduct several site visits in order to evaluate the existing ecological conditions. The assessment should focus on obtaining baseline data of the biological environment in the project area. This is to highlight any environmental concerns that may arise upon the implementation of the proposed project on the existing biological conditions during construction and operation phases. Moreover, the study should recommend approaches to reduce any potential threats on endangered species to comply with national and international protection requirements.

8.2.4 Socio-economic Study

A socio-economic study should be conducted to investigate the socio-economic and demographical characteristics of the project area. Both qualitative and quantitative data collection and analysis should be carried out. The quantitative approach enables the socio-economist to thoroughly analyze the socio-economic conditions of the people in the project area; the qualitative approach will enhance interpretation of the quantitative data.

The study should discuss the socio-economic changes influenced by the project. The socio-economist should hold focus discussion groups meetings to survey and assess the public perceptions and views of the local community in the project area. In addition, the socio-economic study shall also highlight the influence of the local social norms and socio-economic conditions on the project.

The study should recommend mitigation measures for adverse impacts. According to the scoping session findings, economic equity will be further discussed as one of the main issues.

8.2.5 Human Health Assessment

Statistical data and information related to health conditions at the area should be collected, along with identifying health-related issues resulting from construction and operation of the project. Information can be obtained via different official entities and through face-to-face interviews with people working onsite.

8.3 Scoping

Project stakeholders and affected communities should be invited to participate in a scoping session. Public consultation in early stages of the project can prevent potential problems that may otherwise arise in more serious forms at later stages in the review process.

The scoping session should identify and discuss environmental issues associated with the project. Names of participants and details of the scoping session's activities should be documented in the EIA study.

8.4 Environmental Impact Identification and Assessment

The EIA team shall identify and assess the anticipated impacts using the Impacts Description Matrix. The matrix shall cover the following elements:

- Nature: this indicates whether the impact on the environment is positive or negative, in addition to its extent, as follows:
- Significance: the impact should be classified as highly, moderately or mildly significant
- Reversibility: the impact should be classified as reversible, partially reversible, or non-reversible
- Likelihood: the impact should be classified as very likely, likely, or unlikely to occur
- Duration: the impact duration should be provided as long-term, short-term or an actual time will be specified
- Geographic extent / location: the geographic extent of the impact should be provided (e.g. area, village, and country)

The outcomes of any investigations and surveys conducted should be incorporated and evaluated in the EIA report. Consequently, the identified impacts should be thoroughly described and quantified where possible.

8.5 Environmental and Social Management and Monitoring Plan Development

A comprehensive ESMP shall be developed to verify that the required mitigation measures and monitoring activities are implemented and sustained throughout the progress of the project. In order to facilitate the identification of mitigation measures and monitoring activities, the ESMP should be presented in a tabular format and should include the following:

- List of environmental and social objectives
- List of mitigation measures for various phases of the project
- Designation of the parties responsible for implementation
- Description of any training needs
- Time schedule for implementing proposed mitigation measures
- Monitoring plan for certain parameters
- Inspection and plan review schedule and methods
- Public reporting
- Proposed corrective actions

8.6 Approvals

The Terms of Reference document, along with the scoping session report and all reports related to the baseline studies, should be incorporated in the EIA report and submitted to the environmental department at ASEZA for review and approval.

8.7 Disciplines Required

The following experts are expected to participate in the preparation of the EIA:

- Environmental Task Leader
- Environmental Specialist
- Socio-economist
- Ecologist
- Archaeologist
- Air Quality Expert
- Health and Safety Specialist
- Geologist

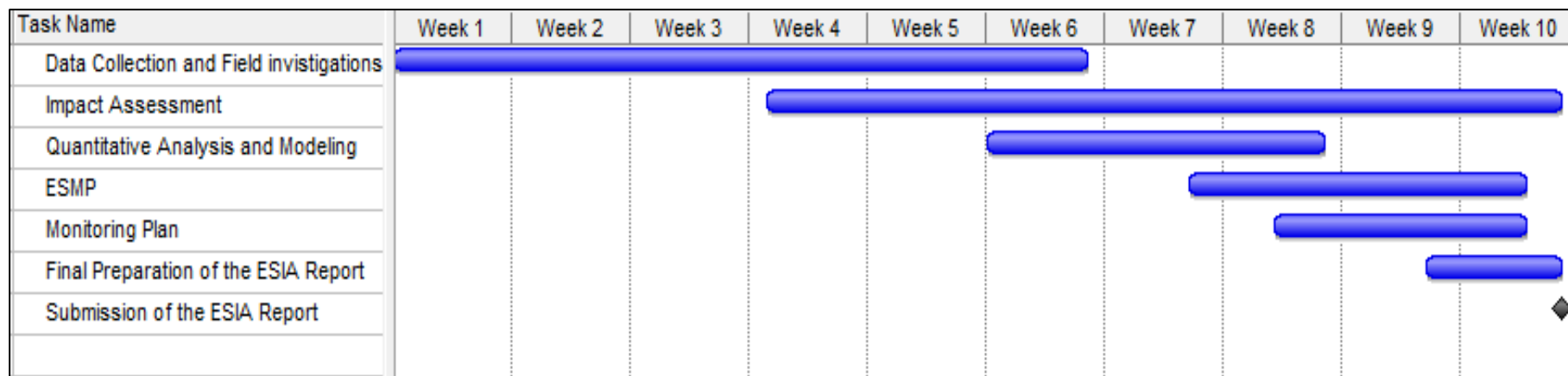
Curricula vitae of involved experts should be provided within the EIA report.

8.8 Proposed EIA Report Outline

The EIA report should include the following contents:

- Executive Summary
- Background and the Purpose of the Project
- Regulatory Framework
- Alternatives including the Proposed Action
- Affected Environment
- Expected Environmental Impacts
- Environmental Management Plan
- Monitoring Plan
- List of Preparers
- Appendices

8.9 Schedule



9 CONCLUSIONS

Based on the above discussion, project implementation is anticipated to minimize the current adverse impacts on soil and occupational health. Although there may be some potentially adverse impacts associated with the construction of the landfill, these impacts are temporary in nature and can be mitigated. Implementing the proper mitigation measures will be imperative during construction and operation of the proposed project.

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APPENDIX A:
Conditions for Development within Conditional Development Areas

ANNEX B CONDITIONAL DEVELOPMENT AREAS (CDA)- DEVELOPMENT CONDITIONS

CDA: Introduction and Definition:

The ASEZ Master Plan 2011-2030 identifies Designated Development Areas' which include Built-up Areas, Infill Areas and Expansion Areas. All growth that occurs within the 20 year planning period should occur within these DDAs. The Master Plan also identifies Special Project Areas which include the existing planned projects of Saraya Aqaba, Ayla Oasis and Marsa Zayad. Land that is considered inappropriate for any development, both within and beyond the Planning Period, are designated as 'Preservation Areas' and include mountains and major drainage wadies.

In general, land designated on the ASEZ Master Plan 2011-2030 as 'Conditional Development Area' or CDA is all developable land that falls outside of Designated Development Areas, Special Project Areas and Preservation Areas. This land is not needed to absorb growth within the 20 year planning period and therefore constitutes a development reserve for growth beyond 2030. To develop this land before the full utilization of the DDAs would be inconsistent with the principles of the Master Plan for compact growth and urban efficiency.

In order for land designated as CDA to be approved for development within the planning period, the conditions outlined below should be complied with:

CONDITIONS:

A. Committed Project Prior to 2011:

All development projects for which legally binding commitments have been made by ASEZA or ADC prior to 2011 must be approved for implementation regardless of location. The details of each legally binding commitment must be honored by both ASEZA/ADC and the project Owner/Developer. The following qualifications apply to the status of these committed projects:

A.1 ASEZA/ADC should examine the status of each project to confirm viability and the commitment and capacity of the developer to proceed through implementation. Negotiations should be initiated to convince the Owner/Developer to consider a more appropriate site consistent with the principles of the Master Plan and located within the DDAs

A.2 All project proposals should be required to demonstrate project feasibility and marketability with completed studies to be submitted and reviewed by ASEZA/ADC. A minimum standard for preleased or pre-sold space within the project should be established and complied with before project approval to proceed.

A.3 All land allocations should be based on actual land requirements as demonstrated on a detailed site development plan and market feasibility. If the project is phased then the land allocation should be phased as well. Any developer should get only as much land as they can develop within a limited time frame.

A.4 All projects must comply with required latest dates for construction start-up, progress and completion according to an agreed upon schedule. Failure to achieve these benchmarks should result in a reconsideration of the term of the commitment agreement.

B. New Projects and Development Proposals:

All development project proposals for CDAs without pre-existing commitments from ASEZA or ADC should not be approved by ASEZA/ADC unless in full compliance with the following conditions:

B.1 Before a project can be approved for a site within CDAs, there must be a substantial completion and utilization of appropriate alternative sites within DDAs. Specifically, a project requiring a particular land use category will not be considered for a CDA site unless 75% of the land of that use type (example: Resort-Tourist) within DDAs has been fully developed.

B.2 If the proposed project site is in compliance with B.1, the site is required to be directly adjacent to completed developed in a DDA in order to prevent 'leap frog' development or isolated 'islands' of development. In general, new projects shall be consolidated near to or adjacent to Built-up areas and the growth and development direction should be west to east or coastal to mountain. For industrial sites, special requirements that effectively mandate project separation and buffer zones can be considered.

B.3 Full Compliance with A.1, A.2 and A.3 above is also required.